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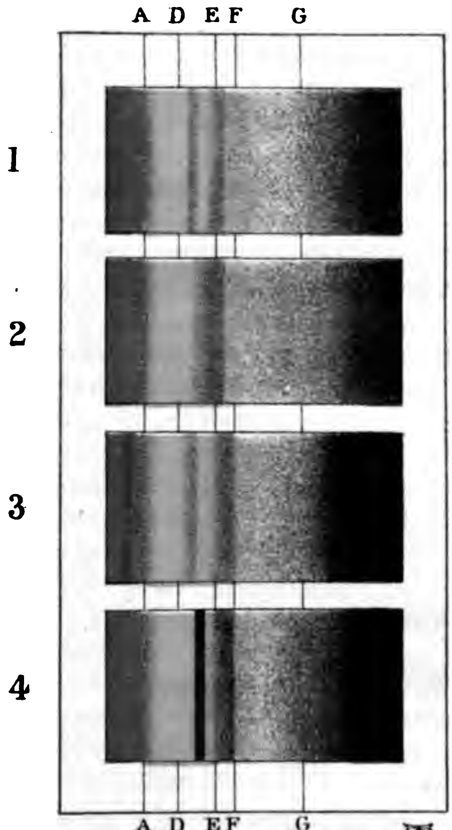

II

1. *Spectrum of Scarlet Hæmoglobin, (Oxyhæmoglobin).*
2. *Spectrum of reduced Hæmoglobin.*
3. *Spectrum of blood after prolonged exposure to air, (Methæmoglobin).*
4. *Spectrum of reduced Hæmatin.*

H. BEN

LEGAL MEDICINE

BY

CHARLES MEYMOTT TIDY, M.B., F.C.S.,

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THE HONORABLE SIR JOHN WALTER HUDDLESTON,

BARON OF THE EXCHEQUER, AND ONE OF THE JUSTICES OF THE HIGH COURT OF JUSTICE.

---

3 Mandeville Place, W.

May 1st, 1882.

My Lord,

I thank you for permitting me to dedicate this book to you, and for the interest you have taken in its preparation.

As a Member of that Judicial Bench known throughout the world for its integrity and impartiality, its love of learning and of right, the countenance of no better name than your own could have been found, as a real assurance that our highest authorities are willing to encourage the humblest efforts made in the investigations of science, and in the exaltation of the truth.

I remain,

Your Lordship's faithful Servant,

C. MEYMOTT TIDY.

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PREFACE.

It is not without a feeling of the most solemn responsibility that I have undertaken a task of which this volume is the first instalment. I use the words "solemn responsibility" advisedly. For if anything I write should hereafter be quoted to condemn the innocent or to gain a verdict against right, then indeed most truly could I wish the book had remained unwritten.

Some years ago, when engaged, with one prematurely lost to our profession, in the preparation of "A Handybook of Forensic Medicine and Toxicology," I determined that I would one day attempt a more or less complete treatise on Legal Medicine. To the fulfilment of that design, the spare hours of a somewhat busy life have been devoted. Two things, it was evident, had to be done if such a work was to be of any special value to the lawyer and physician:—

First, and before a word could be written, it was necessary to collate from English and foreign literature all recorded cases having reference to the various subjects under consideration. The numerous errors that had crept into the published records, rendered it impossible to guarantee accuracy without consulting the original reports. It was a matter of no small difficulty to determine how best to utilize the enormous mass of material thus collated. Experience had taught that to quote long cases in the text in illustration of one single point, was certain to disturb the continuity of the argument, by the inevitable introduction (in order to render the history complete) of numerous details, irrelevant to the subject under consideration. I decided therefore to print the cases at the end of the chapter they served to illustrate, and to refer to them in the text by number only.

Secondly. It became necessary, for the purpose of clearing up

what was ambiguous and of reconciling what was contradictory, to institute new inquiries and conduct fresh experiments in most of the subjects. So far as circumstances have permitted, I have endeavored, whenever the study of recorded cases indicated doubt, to investigate the subject *de novo*. I must admit that it was here one's chief anxiety occurred. To shirk the manifest conclusions of experiment, because such conclusions are not in harmony with the generally received opinions of authorities, is unscientific timidity. On the other hand, dogmatically to state as facts the conclusions drawn from one's own experiments, more especially when such conclusions are at variance (as at times will be the case) with those arrived at by others who have adopted different (it may be better or worse) methods of research, may seem to partake of scientific venturesomeness. And those only who in Science work have felt the difficulty, and yet the necessity, of avoiding the extremes of timidity and venturesomeness, can realize how that difficulty becomes intensified when, as in Legal Medicine, the subject relates to such serious issues as imprisonment or freedom, and it may be life or death.

For the medical jurist, whose object should be the interests of justice, to hesitate where science is positive, is as unjustifiable as for him to speak without reserve on those details of our science, where the limits of exact scientific knowledge are undefined. There is a scientific certainty which only the coward treats as uncertainty, and there is an uncertainty which only the boldness of ignorance ignores.

The subjects dealt with in this volume constituted the basis of my course of Forensic Medicine Lectures at the London Hospital during the Summer of 1881. I have however dropped the Lecture form, except in the first chapter, where I have retained it as the most convenient method of dealing with various questions otherwise difficult to discuss.

In addition to a general Index, and an Index of Cases, I have added a paged *précis* of Contents in order to facilitate reference.

It is impossible for me to acknowledge as I could wish the assistance I have received from friends in the preparation of this work. First of all, I must express my indebtedness for much valuable matter, characterized by a depth and originality of thought, and a rare grasp

of details, to the manuscript notes of my old master and colleague, Dr. Letheby, who at his death entrusted his papers to my care.

I desire to express my thanks to Mr. Michael J. Michael, Barrister-at-Law, for the important help he has rendered me in dealing with many legal questions. It is only right to say, that much I have written is due to his friendly assistance.

My thanks are due to Dr. Fenwick, Dr. Dobell, Dr. Sansom, Mr. McCarthy, and Mr. Treves for very valuable help. In the section on Blood I am under great obligations to my kind friend, Dr. Sorby.

I desire to record my special thanks to my distinguished friend, Mr. Moulton, for his ever ready assistance. Let me add that but for him I might never have had the courage to send the manuscript to press.

To one other I am indebted in the preparation of this volume and of those I hope may follow, far more than I could express or others would suppose. But to write more of this would be to speak of days too painful to recall.

8 Mandeville Place, London, W.

May, 1882.

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SEX.

MONSTROSITIES—HERMAPHRODISM.

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LEGAL MEDICINE.

CHAPTER I.

IMPORTANCE OF THE STUDY OF FORENSIC MEDICINE.—THE PROCESS OF LAW—The Coroner's Court—The Magistrate's Inquiry—The Grand Jury—The Trial.—EVIDENCE—Matters not requiring Evidence—The Functions of a Witness Defined and Compared with those of the Jury—Evidence must relate to the Questions at Issue—Evidence of Character—Hearsay not as a Rule Evidence—Exceptions to the Rule that the Evidence of absent Witnesses is inadmissible—Dying Declarations—Varieties in the Character of Evidence—Expert Evidence.—THE WITNESS BOX: Examination-in-Chief—Use of Notes—Quotations from Authorities—Medical Secrets—Cross-Examination.—PREPARATION FOR THE WITNESS BOX AND SUGGESTIONS AS TO GIVING EVIDENCE—Facts and Opinions.

INTRODUCTORY.

GENTLEMEN,—I pray your more than ordinary attention to the subject matter of this course of lectures. It were well for us thus early to grasp the importance and the responsible nature of our task. The subject is not one that admits of postponement for a more convenient season. Your first day in practice—the first ring at your bell—may bring you face to face with a medico-legal case requiring all your thought and acumen—powers of observation—knowledge of facts—habits of induction. The body of an infant is discovered—was it born dead or alive? A lifeless wounded body is found—were the wounds inflicted before or after death, and were they homicidal, suicidal, or accidental? A body is recovered from the water—was it alive or not when immersed? A girl lodges an accusation of rape—are there any, or no grounds for such accusation? You are called to see a patient—is his illness natural disease or the effects of poison? These are examples of the many hundred questions, any one of which, I say, your first day's practice may require you to consider. For the practice of forensic medicine is one that devolves on the profession generally, and not on a few in particular. I admit that in any great

case, experts (as they are called) are usually consulted; but for the actual facts and conditions, the appearances, symptoms and the like observed at the moment, the general practitioner must, as a rule, be alone responsible.

And for a moment allow your minds to grasp to the full the responsibilities involved in the practice of legal medicine. Begin, if you like, by a selfish consideration—anything to make you true, careful, and diligent. Think of the responsibility so far as your own position is concerned. The evidence given, and the opinions expressed by you in open court, even if that open court be but a village inn, may be reported in thousands of papers, and be conned over, discussed and criticised wherever the English tongue is read. Depend upon it, if your evidence in any case be one-sided, if your judgment be biassed, if your opinions be not founded on knowledge, or be swayed, either for or against the accused, by popular sentiment, by friendship, or by a want of common sense and science, that one medico-legal case may mar your career, as it may, if you bring thought, learning, power, judgment, discrimination, discretion, common sense to bear upon it, make it. But to be unselfish, think how often the medical evidence, more especially in a criminal case, determines the verdict, and how pregnant with meaning to the prisoner as he stands in the dock the verdict of the jury is. Realize the force of that word "Guilty," as it falls from the lips of the foreman. It seems to seal to many a hideous life-future, the ruin of a prisoner who has done a wrong—the crushing of a family, may be, who have done no wrong. Do not misunderstand me. I would not for an instant urge upon you the painful effects of your evidence (no matter how painful) for any other reason than to quicken your judgment and to intensify your care, save to urge that you estimate every detail to the best of your ability at its right value, and in no sensational or unfairly sympathetic spirit. Be jealous for truth, careless whom you please or displease. Let not your judgment be influenced one iota either by policemen who are "working up" a case, or by the solicitor who is conducting it. Be careless which way the verdict goes so long as your evidence is that of honest conviction, of intelligent judgment and of accurate observation.

The work before us is not easy, and it would be folly to lead you to think it was. The power to endure bravely any arduous physical effort (such as climbing an ice-mountain) depends much on previous training—on realizing the necessity for hard work, and on the determination to succeed. But more than this—safety depends on looking the difficulties and dangers straight in the face. They must first of all be realized as difficulties and dangers; not exaggerated I admit, but

not pooh-poohed for fear that our courage may be regarded by others, or appear to ourselves, mere womanly fear. No! eye the dangers well, and then bring to them a strong wiil, unflinching boldness and determined courage. And the elements of success in intellectual work are very much the same as in physical effort. You have had a certain professional training, and you now come, at the close of your student days, to learn the applications of that work to law, and to be told how to apply your knowledge so as to escape the numerous difficulties to be encountered in the practice of forensic medicine. The habit of observation that the physician insists upon so strongly as essential to a good practitioner, I would urge yet more strongly as *the* essential of a good medical jurist; for it is not unlikely that your observations may have to be conducted under difficulties of a most unusual nature, different to-day from what they were the day before—in the face, I mean, of a moral dust-cloud that some in attendance may have an interest in raising to blind your eyes or to obscure your vision.

I said at the outset, Let us realize *our* responsibilities. As your teacher and guide, I would endeavor to realize mine. If I appear dogmatic, remember it is my duty to direct you along the path I believe to be right. You are at all times entitled to demand reasons for my dogmatism—reasons why I reject lines approved by certain authorities, and adopt others. Whilst, therefore, I shall point out to you, "dogmatically," what in my judgment is the true course, I shall also endeavor to discuss the views advocated by those who have devoted attention to the several subjects that will come before us in our course of lectures, and which, whether we accept their conclusions or not, should at all times receive respectful consideration.

The Process of Law.

Probably the coroner's inquest will be your first experience of courts of justice and legal inquiries. The duty of the coroner's jury is—(1) To view the body of the deceased person on whom the inquest is to held (that is to make sure of the death); (2) To hear evidence as to who the deceased person was (that is to establish identity); and (3) To decide the cause of death. Such an inquiry practically necessitates medical evidence. If medical evidence be not required, then as a general rule the coroner's inquest is not required, and *vice versâ*. To establish the *fact of death* as well as the *identity* of the person, may require medical evidence (oftentimes of a most involved character), but to determine the precise *cause of death* must as a rule demand it. Thus the post-mortem examination of the body is an inseparable part

of the coroner's inquiry. So important is it, that under no circumstances should the medical man undertake, either to perform an autopsy under circumstances of hurry, *e.g.*, during the sitting of a jury, or at an improper time, *e.g.*, by artificial light, when certain important appearances (such as the yellow color of the skin induced by picric acid poisoning, etc.), might, and probably would, pass unnoticed.

In a case of grave suspicion and where important issues are at stake, the post-mortem should be performed by at least two independent experts. If the medical man himself be in any way inculpated, or his treatment called in question, it is unadvisable for him to be present, although it is only fair, if he wish it, that he should be represented at the examination by a friend. A case is known to me, where a medical man accused certain sisters of mercy of poisoning with opium a child that had been placed under their custody in a crêche. A post-mortem was ordered by the coroner, and a friend was present on behalf of the sisters. The examination was conducted by the practitioner who made the charge. At the inquest he stated that the post-mortem revealed all the appearances of death from opium, but did not state until he was cross-examined that the liver was in a condition of complete fatty degeneration. This would probably never have come out as the primary cause of the death, had not a representative of the sisters been present at the autopsy. As a matter of prudence, therefore, neither the accused nor the accuser, nor in fact any one actually suspected, should be present during the operation, inasmuch as tampering with viscera and the contents of the stomach, are circumstances not altogether unheard of in forensic literature.

The coroner's jury may return a verdict of manslaughter or of wilful murder against some person known or unknown. The case now may, or may not, undergo further investigation in the magistrate's court. The nature and scope of the inquiry before the magistrate differs from that before the coroner in this respect:—The coroner's jury are called upon to decide *the cause of death.* This, as a matter of fact, is the special, if not the only object of the inquest. Hence, as a rule, a suspected person is not present at the coroner's inquiry. But the magistrate has to inquire, not so much the actual cause of death, as whether an accused person was, or was not, concerned in causing it. Before the magistrate, therefore, the person suspected is always present in custody. These (viz., the cause of death, and the person who caused the death) are really two different issues, and however much they are necessarily associated, there are many obvious reasons why they should be regarded as distinct. An inquest is held whether suspicion attaches itself to any one or not, but a magistrate's inquiry is only held when

some person or persons are actually suspected of being concerned directly or indirectly in causing the death.

Either on the coroner's warrant, or by the magistrate's decision to send the case to a jury, or by both, a prisoner may be committed to take his trial for murder or manslaughter as the case may be, and the medical witness with the other witnesses be bound over to appear and give evidence. It may be worth remarking here that the depositions taken at an inquest and before the magistrate are not only sent to the judge, but are certain to be in the hands of counsel, and to form a serious weapon for cross-examination should any discrepancies occur in the evidence given by a witness at the trial and that given at these preliminary inquiries. It is most advisable that *all the facts* known to a witness should be stated both before the magistrate and the coroner. Facts stated at the trial for the first time commonly provoke severe comment, counsel representing them to the jury rather as the invention of the witness (by no means necessarily wilful), than as an unvarnished record of what occurred. In all cases the facts stated, and the facts *as* stated, with the least possible delay after their occurrence, are regarded of greater value as evidence, than those remodelled or recalled after an interval. And this is as it should be, considering how imperceptibly and unintentionally, by the mere dwelling on a case, or by discussing it with others, a certain coloring may be imparted, or an importance ascribed to certain details, which may be unreal or even imaginary.

In a criminal case where the prisoner has been committed by the magistrates for trial, a preliminary inquiry is held by what is called "*the grand jury.*" Where a prisoner, however, has been committed on the coroner's warrant only, he is then tried by the petty jury, without the grand jury being called upon to hear the case. In practice, where the case has been heard both by coroner and magistrate, it is the usual custom to send it before the grand jury. Their duty is merely to hear what the witnesses for the prosecution have to say without cross-examination, and to call so much of the evidence as in their judgment is necessary either to find a "true bill," when the case goes for trial, or "no bill," when the whole matter is at an end and the prisoner discharged. Thus the medical witness may, or may not be called before this tribunal, although his presence (should he be wanted) under his subpœna is imperative. Neither the prisoner nor his counsel are present, the special points for the consideration of the grand jury in the several cases being referred to in the "charge" of the judge that precedes their labors.

A true bill being found, the case now comes before the judge and the petty jury for trial.

Evidence.

In law the burden of proof (*onus probandi*) rests on the prosecution, or on that side in an action that states the affirmative. Proof is invariably a matter of evidence, and, without entering upon any legal subtleties, it is very essential that we should have clear views as to what constitutes evidence, and on the other hand, what is inadmissible as evidence. It is often a matter for regret that medical men neglect the study of the rules of evidence, and suffer accordingly.

There are certain matters which need no proof. Such, for example, are things that occur within the constant and invariable course of nature. No evidence is needed, for example, to prove if a woman be confined with a living child, the husband only having access to her a month before, that he could not be its father. If, however, a living child be born within a period where the husband might, in the opinion of certain authorities, be the father, such an opinion being contested by others, then evidence may be given by the several authorities of their experience, the jury being called upon to decide between the opinions expressed, in their special application to the case before them.

And this suggests a word on the relationship between the evidence given by an expert and the functions of the jury, which latter are not to be usurped by the former. Thus the exact fact which the jury are called upon to decide, or the precise question at issue between the parties in a civil cause, cannot be a matter of evidence as the opinion of an expert. To draw a rigid line is often a matter of the greatest possible difficulty both for counsel and for witness, and in but few medico-legal cases is this difficulty more apparent than in defending a prisoner on a charge of murder, where the guilt is admitted, but unsoundness of mind urged as the excuse. The trial of Sweetland for murder (known as the Holloway murder case) supplies an illustration of this difficulty. Witnesses were called to prove certain peculiarities of manner, which peculiarities had specially developed themselves after certain severe accidents. A well-known expert was called to give evidence for the defence. The judge, however, ruled that the following question was inadmissible, on the ground that it was practically asking the witness the very question that the jury were there to determine, viz., Having heard the evidence given by the several witnesses, was the prisoner, in your judgment, at the time he committed the act, of sound or of unsound mind?

The following questions, however, Mr. Justice Hawkins allowed,

their special characteristic being that they are *general* and not special:—

1. Given in any case certain peculiarities of habit, manner, etc., such as—[here counsel detailed the main peculiarities proved in the case of the prisoner]—are such peculiarities, in your opinion, inconsistent with soundness of mind?

2. Are they indicative of insanity?

3. If you were informed that such peculiarities specially developed themselves after an accident, such as—[here counsel detailed the accident that had been proved to have occurred to the prisoner]—would this circumstance more strongly support to your mind the opinion you have expressed that these peculiarities indicate unsoundness of mind?

4. Is it within your experience that such peculiarities which you say indicate insanity, may result, and are likely to result, from an accident such as I have mentioned as an exciting cause, more especially if there be an hereditary predisposition in the person to unsoundness of mind?

In a case of suspected poisoning (*R.* v. *Wilmot*) the medical man stated that certain symptoms be noted and described were consistent with poisoning by strychnia. Mr. J. Manisty ruled against the next question—"Do you consider these symptoms were the result of the exhibition of strychnia?" but allowed the following—"What in your opinion was the cause of the symptoms that you say were consistent with poisoning by strychnia?"

The rule which in criminal cases is strictly observed (however it may be occasionally relaxed in civil causes), is that *no evidence can be given foreign to the question or points at issue;* in other words, evidence must not be offered in proof of collateral facts, unless fair and reasonable inference can be adduced therefrom in proof of the points in dispute. Whether the evidence on collateral facts admits of being fairly applied is for the judge to determine, although he is compelled in a great measure to trust to counsel whether the facts will turn out to be material. In certain cases, however, evidence on collateral facts constitutes important evidence on the points at issue. Thus, if a surgeon is prosecuted for want of skill and judgment in a certain case, evidence is admissible of his general skill and judgment in cases of a like kind (*Wells Harbor Case*, 2 Stark, Ev., 382). Or again, in an indictment for murder, previous threats or expressions of ill-will by the prisoner toward the deceased are admissible in evidence as proof of ill-feeling, but not other acts of ill-will expressed by him toward other persons. Again in a murder case, the possession by the prisoner of property proved to belong to the deceased may constitute important

evidence in proof of the murder, but evidence cannot be adduced to show that the prisoner committed a burglary (for which he is not indicted), unless such evidence is material in support of the capital charge. Thus, in the St. Albans murder case (*R.* v. *Wheeler*), the prisoner shot his victim with a gun, stolen (it was believed) some time previously from a house in the neighborhood. The particulars of the burglary at this house, connecting as it did the gun stolen from it with the gun in the possession of the prisoner, became important evidence in proof of the charge of murder.

But there is another case where the evidence may take a somewhat wider scope than the exact point at issue, and that is in the matter of *character*. But here there are distinct limits. Evidence of character as an integral part of a case, is only admissible if it be necessitated by the nature of the proceeding. Thus, in criminal cases, evidence of general good character may furnish a presumption that the prisoner has not been guilty of the crime alleged, such general evidence being always open to cross-examination as to the grounds on which the witness's belief is based.[1] In a charge of rape, or attempted rape, evidence in defence is permissible to show the unchastity and general bad character of the prosecutrix, and this although she may not in cross-examination have been asked any questions impeaching her chastity. Or once again, in a question of illegitimacy, evidence having been offered of probable non-access on the part of the husband, it would then be admissible to prove that the mother was a person of bad character.

As a rule evidence of character does not, however, form a part of the actual case. In the event of a prisoner being found guilty, the judge may then hear evidence of previous character to guide him in pronouncing judgment. And the justice of this is obvious. A man may commit a criminal act, however unblemished his previous character, and the jury have only to decide the yea or the nay. But the previous good character of the prisoner convicted of the charge should, and always does, weigh with the judge as to the sentence he passes.

As a general rule *hearsay is not evidence*. The law believes no man's bare assertion (be he prince or peasant), but requires his actual presence in court, the sanction of an oath or its equivalent, and the opportunity for cross-examination. But even this rule has its exceptions. For example, in cases of pedigree, prescriptions and custom, the statements of the dead are admitted as the only possible means of getting at the facts. Or, again, if the hearsay be a part of the actual transac-

[1] "In civil cases the fact that the character of any party to the action is such as to affect the amount of damages which he ought to receive, is generally deemed irrelevant." —*Fitzjames Stephen.*

tion (*i.e.*, part of the *res gestæ* in question and not merely a medium of proof), it may be received at the discretion of the judge. In a breach of promise case for instance, where the defendant pleaded the bad character of the plaintiff, a witness was allowed to be examined as to representations of character made to him by third persons, character being a matter of general repute (*Foulkes* v. *Selway*, 3 Esp., 236). Or, again, if a witness has heard a second witness since dead give evidence on oath at a trial, he may repeat on oath what he heard that witness say, but the repetition must be the precise words uttered, and not the mere general effect of the evidence.

Evidence is therefore received in exceptional cases without the personal attendance of the witness. For he may be dead. Thus if a witness, having given evidence in a case on oath and been open to cross-examination, die, his evidence will be admitted in any subsequent suit between the same parties, provided always that the evidence involves the same material questions. Or, supposing one man to have stabbed another, the evidence of the injured man can be used against the prisoner on an indictment for murder, if the injured man should afterward die from the wound received.

And this suggests two cases of a like kind where the medical man may be called upon for an opinion. In the case of *R.* v. *Savage* (5 C. & P., 143), it was decided that the evidence given by a woman when a case is before a magistrate cannot be afterward used at the trial, on the ground that she was unable to attend because near her confinement. This case, however, was decided in 1831, and before the passing of the 11 & 12 Vic. 42. Since that statute it has been held by the Court for Crown Cases Reserved (*R.* v. *Stephenson*, L. & C., 165), that "there may be incidents attending an approaching parturition of such a nature as to make it an illness within the meaning of 11 & 12 Vic. 42, s. 17." "The question whether the illness proved is or is not within the statute is a question for the determination of the judge presiding at the trial, and this court will not interfere with the exercise of his discretion." In the case referred to, the brother of the witness who had given evidence before the magistrates swore that she was daily expecting her confinement, and that she was "poorly otherwise," and upon that her deposition was admitted.

Again, where it is proved that a witness is too ill to travel, the deposition of that witness taken before the committing magistrate may be read as evidence, provided such deposition was taken in the presence of the person accused, and full opportunity for cross-examination permitted (11 & 12 Vic. 42, s. 17).

Where it is proved that there is no reasonable probability that the

deponent will ever be able to travel or to give evidence, a deposition made by a witness, although not taken before the committing magistrate, may be given in evidence. Such deposition must, however, have been made in the presence of a magistrate and signed by him. Reasonable notice of the intention to take such deposition must also be served upon the person (whether prosecutor or accused) against whom it is proposed to be read, and it is also necessary that such person, or his counsel or attorney, had, or might have had if he had chosen to be present, full opportunity of cross-examining the deponent.

The law requires all evidence to be given on oath, or what is equivalent to an oath. But here again there are certain exceptions. Thus in an indictment for manslaughter, a statement made by the deceased immediately after he was knocked down, as to how the accident happened, has been held admissible (*R.* v. *Foster*, 6 C. & P., 325).

But the main exception to the necessity for an oath is in the matter of *dying declarations*. And here three points must be strictly noted so as to render such declarations without oath, of equal value to evidence on oath:—

(1.) The person must believe he is in actual danger of death.

(2.) He must believe his recovery to be impossible.

(3.) To make the declarations admissible as evidence, death must have ensued.

The law presumes that no one would willingly leave this world with a lie in his mouth, and that if at so solemn a moment an accusation be made, it is at least sincere.[1] In the case of *Jenkins* (Crown Cases

[1] It may be sincere without being true. Dr. Taylor cites (p. 455) the case of a dying woman in St. Thomas's Hospital, who accused a man of assaulting her on Kennington Common. He was found guilty, and executed. A year after his execution the real murderers were discovered, and his innocence established.

The following cases (quoted by Taylor) may be referred to on this point:—

(1) Chief Baron Pollock ruled in *R.* v. *Bayley* (Exchequer Chamber, Jan., 1857), that although the surgeon had given some hope to the dying person before the declaration, his declaration might be taken as evidence, because, in spite of the surgeon, he believed he should not recover. (2) *R.* v. *Harvey* (Exeter Summer Assizes, 1854), Justice Wightman. (3) *R.* v. *Wanstell* (Leeds Autumn Assizes, 1869, and *R.* v. *Pettingill* (C. C. C., April, 1872), Baron Cleasby ruled that the dying person must either expect death, or death be imminent, even when a magistrate has taken the deposition. (4) In *R.* v. *Barrett* (Leeds Lent Assizes, 1869), Baron Cleasby ruled against a declaration, because the strongest statement was that "she thought she should not recover." (5) In *R.* v. *Qualter* (Stafford Lent Assizes, 1854), the surgeon was, as we think, unjustly blamed for the escape of the criminal through a technicality of this kind.

See also the case of *John Clark*, tried in December, 1873, for "killing and murdering *Thomas Johnson*, by stabbing him in the belly," etc. "The declarations of the deceased," said the Judge, "after receiving the death-wound, are always considered as

Reserved, April, 1869), a statement was rejected because the dying person, in using the expression, "I have no hope of my recovery," requested that the words "at present" should be added. In *R.* v. *Londesborough* (York Lent Assizes, 1871), Mr. Justice Brett declined to receive a statement because the evidence went no further than that the dying youth said he thought he should not get better. Chief Justice Erle, in Seton's case (*R.* v. *Pym*, Hants Lent Assizes, 1846), said, "The law admits these declarations, not because recovery is impossible, but because there is in the mind of the person making them the conviction of approaching death."

Still there are cases where these rules seem to have been somewhat relaxed. Thus, in the case of *R.* v. *Morgan* (Cox C. C., vol. xiv., p. 337), a question arose as to the admissibility of dying declarations by the subject of the homicide where the wound was serious but no actual fear of immediate death expressed by the person. In this case (a trial for murder) the death was caused by the prisoner cutting the throat of his victim. The deceased about five minutes before his death and when actually dying made the declaration in writing, having at the time no power to speak. This was proved by a witness who saw the deceased come staggering out of the hut with his throat cut. It was held by Denman, J., after consulting Cockburn, C. J., that the declaration might be admissible; but that, having reference to certain decisions, and especially *R.* v. *Cleary* (2 F. & F., 850), it would be proper, if admitted, to grant a case for the C. for C. C. R. The learned Judge required that the whole of the evidence should be before him previous to deciding whether the declaration could be received.

[Cases cited in note to this case:—*R.* v. *Reason and Tranter*, 1 Strange Rep., 499; *R.* v. *John*, 1 E. Pleas of Crown, 357; *R.* v. *Tinkler*, 1 E. P. C., 354; *R.* v. *Woodcock*, 1 L. C. C., 500; *R.* v. *Mead*, 2 B. & C., 605.]

In the case, however, of *R.* v. *Bedingfield*, a somewhat different course was adopted. This case was an indictment for murder, in which it appeared that the deceased, with her throat cut, came suddenly out of a room in which she had left the prisoner, who also had his throat cut and was speechless. Immediately on coming out she said something, and a few minutes afterward died. It was held that the statement made by her was not admissible, either as a dying declaration,

admissible evidence in cases of murder, though nothing before that wound is considered in that light. The man is in health; he receives his death-wound; he declares his own idea of it that it will be mortal," etc. ("Select Criminal Trials at Justice Hall in the Old Bailey." Vol. i., Appendix, p. 82, etc. Edinburgh, 1803.)

or as part of the *res gestæ*. *Sed quære*, whether in a dying declaration, it is not a question of fact, upon the surgical evidence, that from the nature of the wound the person must have been conscious of almost immediate death. See *R.* v. *Bonner*, 6 C. & P., 386.

It is to be remembered that such dying declarations are not available in civil but in criminal cases only; and further, that they are only admissible in cases of homicide where the death of the person making the declaration is the subject of the charge. The declarations themselves, moreover, must relate to the actual circumstances of the death, and to nothing else. Thus the dying declaration of a dead man concerning things done by himself is inadmissible (*Garnons* v. *Barnard*, 1 Anstr., 299). And further, the same rules as to dying declarations hold good as to evidence on oath, viz., that a child of tender years must be proved to have had such religious knowledge as would have made the oath admissible, or if it be an adult, that he had a *religious* sense of approaching dissolution. In the case of *R.* v. *Perkins* (2 Moodie C. C., 135), the dying declaration of a boy aged ten was received as evidence.

And here a word may be added as to the duties of the surgeon in cases where a dying person desires to make a declaration.

If a magistrate or other legal functionary be present, the medical man in charge of the case should not interfere further than to give his opinion as to its hopelessness, and the state of the dying person's mind—that is, whether he be *compos mentis* or otherwise. But should no legal functionary be present, the medical man is undoubtedly the best person to receive such declaration or confession. He must not, however, be officious in extracting information, but should content himself with writing down the *identical words voluntarily uttered* of the sick person, and not his interpretation of them. He should then, if possible, make the dying person sign the confession after reading it over to him.

In the case of certain severe injuries, death is sometimes so sudden that there is no time even to pencil down the words of the dying man. If a medical man be present, he should (whilst endeavoring to prolong life) listen quietly to such statements, only interrupting when he does not hear or understand, and suggesting nothing save to make clear what is ambiguous. This done, he should write down the words so soon as he can get writing materials, and if others have heard them, he should read over to them what he has written, and have the statement attested.

It is allowable for a medical or other witness to give *parol* (or word of mouth) evidence of a dying declaration, but greater weight is

always attached to those statements that are taken down in writing in the presence of witnesses.

Evidence is of two kinds—(1) *direct* or *positive*, and (2) *circumstantial*. Thus, if a witness were to say, "*I am certain that the prisoner is the man I saw knock the deceased person down*," then that fact is proved, so far as any fact is capable of proof. Provided the witness is to be believed, such evidence is *positive*, and the jury have no alternative but to find a verdict in accordance with it. But if the witness were to say, "*To the best of my belief the prisoner is the man*," explaining that at the time the crime was committed the night was dark, or that he himself was flurried, then a doubt hangs over the evidence of identity, which at best is merely *circumstantial*. But even circumstantial evidence is of very different value. Thus *it may be conclusive*. If, for example, A be charged with the murder of B at a certain time and place, and reliable evidence be called to prove that A at the time of the murder was 100 miles away from the place where the murder was committed, (*i.e.*, an alibi,) the evidence is conclusive that A could not have been the murderer. But *circumstantial evidence may be merely presumptive*, *i.e.*, where the inference to be drawn from it is only probable.

A jury must give a verdict in accordance with the evidence. As regards positive evidence, therefore, the credibility of the witness is practically the only point they have to consider. Or, in case of two witnesses giving diametrically opposite positive evidence, the jury have to determine which of the two is to be believed. Still more difficult and delicate is their duty with respect to the circumstantial evidence. And for us it is enough to remember that as scientific witnesses, common or expert, our duty is not to usurp the functions of the jury in venturing to decide the case submitted to them and to them only, but merely, as far as we can, to assist them in their deliberations.

Scientific witnesses may be called either as common witnesses or as experts, or (what is perhaps more frequently the case) both as witnesses of facts and as experts.

1. *A common witness* has to speak to the matters of fact which have come within his personal knowledge. That strychnia was present in the stomach of the deceased, that a dead body he was called to see had sustained severe injuries, that a girl had upon her person on a given day certain marks of violence consistent with having been raped, and so forth, are facts to be proved by the scientific witness, in which, save in the nature of the facts on which he has to give evidence, he in no respect differs from an ordinary witness. Further, if any fact relating to the case be within the personal knowledge of the

scientific witness, a subpœna served on him to speak to that fact in a court of law is as imperative as when served on any other witness.

2. The *skilled* or *expert witness*, as he is termed, is called to state his opinions either on facts observed by himself, or proved in evidence by others. No witness can be compelled to give his opinions in the witness-box. Further, no one is bound to accept a subpœna merely to state opinions. The witness that can speak to any actual fact connected with a case, must attend the trial if he be required to do so, but the expert, however wide his experience, cannot be forced to give the court the value of his general or special knowledge.

The skilled witness must form his opinions on the facts he has heard proved. Thus Mr. Justice Hawkins, in the Staunton case, declined to take the expert evidence of a physician, because he had not been present during the time that the witnesses were giving their evidence, but had based his opinions on the facts submitted to him in writing by the attorney. Hence, it is not enough for an expert to run into court the minute he is wanted, but it is necessary that he should be able to say that his opinions are based on the evidence he has himself heard in the witness-box.

And here a few words are suggested on the vexed question of *expert evidence*. Nothing is more horrible to contemplate than a traffic in evidence either for gain or notoriety. Hence we lay down this definite rule that in our judgment should always guide the scientific expert, viz., that no one is justified in giving evidence in support of a case, or in support of that part of a case upon which he may be specially retained to give evidence, that he does not believe to be right and true. Any evidence offered by the expert in the witness-box should be as honestly and truly his scientific belief, influenced by reasons as definite and as accurate, as if he was arguing the points in dispute before a scientific tribunal, competent to weigh his arguments and pronounce on his opinions with accuracy and precision. Guided by this rule, expert evidence is far from the worthless thing that some would affect to regard it. The truth in disputed cases can only be learnt by a fair statement of different opinions. Whether an unscientific tribunal is capable, or should be required to decide scientific differences, is not the question we are discussing; but given these differences of opinion amongst men of science, if only they be honest, the grounds being stated on which the opinions are based, and the witness being subject to cross-examination by counsel prompted by experts who possibly hold different views, and are familiar with the strength and the weakness of their opponents' position and arguments, no better way, it would seem to me, could possibly be devised to

arrive at *the truth*, which is the object of all legal inquiry. Lawyers would scarcely be prepared to admit that legal decisions are worthless because three judges unanimously on appeal decided a case in favor of the defendant, which three other judges in an inferior court had as unanimously decided in favor of the plaintiff (*Julius* v. *The Bishop of Oxford*, 1879). Neither is it just or fair, on the other hand, that lawyers (as they are fond of doing) should represent the opinions of experts as of no value, merely because differences of opinion exist amongst scientific authorities. In all expert evidence the witness must never for a moment transgress the limits of scientific accuracy, nor, with the warmth of a partisan, or the desire to do the best he can for his case, permit himself to color or distort, directly or indirectly, the hard, straight, and inflexible lines of well attested scientific facts, such as he would never dream of disputing, coloring, or distorting before a learned society.

The Witness-Box.

Every witness is, or may be, subjected to three, and possibly four sets of questions.

1. *Examination-in-chief*:—that is, the rehearsal of the actual evidence the witness is prepared to give in support of the side on which he is called. In examination-in-chief, leading questions (that is, questions where certain answers are obviously suggested) are not permitted. Thus it would be inadmissible in examination-in-chief for counsel to ask a witness, "Did you, as you were passing, see the prisoner push the deceased into the water?" this question merely suggesting "Yes" as the reply. The question must take some such form as this: "What did you see on passing?" the witness answering, "I saw the prisoner push the deceased into the water."

There is, however, one exception to this rule of the inadmissibility of leading questions in examination-in-chief, viz., in the case of "a hostile witness,"—that is, a witness who is compelled to state certain facts within his knowledge, but which he has an object in concealing. Thus the friend or relative of a prisoner may have seen him, and been the only person who saw him, commit a murder. His desire to shield his friend or relative is natural. Yet his evidence is essential to bring home the charge, and to prove the guilt. In the examination of such a witness leading questions in examination-in-chief are necessary, the witness being "hostile" to the side on which he is called.

And here two or three questions arise which, from the medical jurist's point of view, are worth discussing:—

1st. *As to written notes.* The witness must not read his evidence, but he may "refresh his memory" (as it is called) by referring to written notes, provided always that these notes were made *at the time of*, or (if this was impracticable) *immediately after*, the occurrence to which they relate. The notes used must be the original notes and not copies. As a matter of fact judges prefer in some cases evidence where the details have been committed to writing. For example, conversations with a prisoner—the results of a medical examination—the details of an autopsy—are far more likely to be accurately stated when written down at the time that such examinations were made or conversations occurred, than if the witness merely trusted to memory, more especially considering the interval that frequently elapses between the committal and the trial. Again, there must be no additions (the result of after-thoughts) made to the notes, if they are to be used in the witness-box. The actual notes taken at the time of, or at most immediately after, the occurrence to which they relate—uncorrected, unexplained, uninterpolated—are *the* notes to be used, and no other.

2dly. *A witness must not quote authorities in the witness-box.* In the case of a scientific witness there is a great temptation to do so; but it must be remembered that the expert is called to give his opinion, and not to say who agrees or who disagrees with him. Counsel, however, may read a quotation (although not as a quotation) from a book, asking the witness, in the form of question, how far his own view coincides or not with the opinion there expressed. No written or published opinion of a living authority can be quoted even by counsel, the law requiring, if the opinions of such authority be deemed necessary in the judgment of those conducting the case, that the authority himself should be called to state his opinion on oath and be subject to cross-examination.

And here one word of practical advice. If a quotation from the works of a deceased authority is read to you in cross-examination, and you are asked how far you agree or disagree with the opinion expressed, never under any circumstances accept the quotation as expressing the opinion of the authority in question. Neither assent to, nor dissent from the quotation, until you have asked to be permitted to see the book from which the quotation is made. For a counsel may misrepresent the author wilfully or by mistake. One sentence preceding or following the quotation read, will often put an entirely new aspect on the quotation itself.

3dly. *As to Medical Secrets.*—In New York it has been decided that "No person duly authorized to practise physic or surgery shall be allowed or compelled to disclose any information which he may have acquired in attending any patient in his professional character, and which information was necessary to enable him to prescribe for such patient as a physician, or to do any act for him as a surgeon."

The highest legal authorities in England, however, have decided that medical men enjoy no special privilege with regard to secrets of a professional nature. In other words, no practitioner can claim exemption from answering a question, because the answer may or would involve a violation of secrecy, or even implicate the character of his patient. This is the law:—and however it may be defended on legal grounds, we hope there are not a few medical men who would prefer to sacrifice their personal liberty to their honor. It seems a monstrous thing to require that secrets affecting the honor of families, and perhaps confided to the medical adviser in a moment of weakness, should be dragged into the garish light of a law court, there to be discussed and made joke of by rude tongues and unsympathetic hearts.

2. In *cross-examination* (that is the examination of a witness called in support of one side by the counsel on the opposite side) leading questions are the rule. In fact, the witness now occupies, to the examining counsel, the position of a hostile witness. It is in cross-examination that the true power or the true weakness of a witness manifests itself.

Great liberty is allowed (and rightly allowed) to counsel in the matter of cross-examination. Their duty is to do the best they can for their client, by detecting flaws, omissions, and inconsistencies in the evidence of an opposing witness,—by toning down strong expressions,—by seeing how far ignorance of facts or bias may have influenced him, and by putting the best construction on acts and words that tell most against that view of the case it is their duty to advocate. Great as is the liberty allowed the cross-examiner, it is in our experience a liberty (certainly in civil courts) rarely abused. It is the exception, we believe, for counsel to use their liberty as "a cloak of maliciousness." A witness must not be over-sensitive:—still, should counsel abuse his privileges, the witness may then fairly appeal to the judge, placing himself in his hands to decide how far the necessities of the case warrant the severe cross-examination to which he is being subjected. No words can express one's abhorrence at the base use of a great power, when counsel make cross-examination the opportunity for false assertions and untrue insinuations, taking refuge in doing so under the instructions they have received from the attorney.

It is very seldom indeed that a witness is justified in declining to answer a question. Of course, no witness is called upon to reply to any question, the answer to which would criminate himself. I have already suggested, however, that a witness may be morally justified in doing that which legally cannot be supported. But to take so serious a step on the high ground of professional morality, must be no act of momentary impulse, but well considered in all its bearings.

3. In *re-examination*, a good examiner takes care to clear up obscurities in the evidence of his witness, and to make good, as far as he can, the ground lost by cross-examination. The witness cannot be asked in re-examination on any new matter except by permission of the judge; in other words, he can only be re-examined on subjects about which he has been cross-examined, or that arise out of the cross-examination. If by permission new matter be introduced, it will be always open to further cross-examination.

4. Lastly, the judge may see fit to ask the witness certain questions that occur to him as necessary for the purposes of justice.

Preparation for the Witness-box, and Suggestions for giving Evidence.

And here a few suggestions as to how to give evidence may be permitted. They are offered with but one object;—not to teach you to be a skilful partisan, nor a sharp defiant witness, nor to get the best of counsel, but simply for this—that your evidence may be of such a nature, both as regards its arrangement and scope, that justice may be assisted by a clear and orderly statement of the truth and the whole truth, and not perplexed by a disorderly combination of chaff and wheat—a hopeless entanglement of the material and the immaterial.

1. It is your duty to make yourself fully acquainted with, and master of, all the facts bearing on that part of a case upon which you may be called to give evidence. Your knowledge, in short, should be as far complete as possible. As an illustration of what I mean, no medical man is justified in venturing to give evidence on the results of an imperfectly conducted or half-performed post-mortem. Because a death was sudden, and you find on opening the thorax evidence of heart disease, you are not justified in neglecting the examination of the brain. Death is sudden in some cases of cranial hemorrhage, and apoplexy may coexist with, or be caused by, poisoning. In all cases likely to be matters of judicial inquiry, *completeness of work* is absolutely essential for two reasons,—the one to avoid personal censure, and the other to further the interests of justice.

2. Do not think yourself above a careful previous preparation for the witness-box. As you train your body for physical exertion, train your mind for an intellectual contest. The witness has a harder struggle than the cross-examiner (for it is far easier to ask questions than to answer them):—hence by so much let your preparation be the more active and complete.

And for this work of preparation, to which the evening before the day of trial may with advantage be devoted, a few suggestions may not be out of place:—

(α.) Arrange all your facts methodically, and as far as possible chronologically. Make yourself perfectly clear on all dates and times, recalling as far as possible the day of the week as well as of the month, of every important event. In any case where the precise date or time is a matter of question, and important facts turn upon it, it is advisable to recall the circumstances that enable you to speak positively to a specific date or time, as that on which the event happened about which you may be asked.

(β.) Again, where measurements, size, weight, distances of objects, are matters of evidence, these should be carefully considered beforehand. In description, it is advisable to adopt well-known English standards. Thus, speak of inches, feet, yards, etc., rather than of metres; of grains, rather than of grammes; of gallons, rather than of litres. Where, however, absolute accuracy is unnecessary and comparative accuracy sufficient, such common expressions as a finger's or a hand's breadth, or, in speaking of size, the use of such comparisons as the size of a sixpence or of a shilling, or other well-known objects, are often not only allowable but preferable, as common to everybody's comprehension and grasp.

Sometimes an illustrative drawing is of great service in evidence. Thus, in describing injuries, such as cuts, stabs, etc., a sketch (and if life-size so much the better) of the injured part, showing the precise direction and size of the wound, at once renders the whole thing clear to judge and jury when simple description might fail. In fact, there is in certain cases no plan that commends itself more entirely to all engaged on a case than sketch illustrations, or, as we may term it, the graphic form of evidence. Thus a rough drawing, showing the exact position of a dead body as you found it when first called—its relationship to bed, window, table, fireplace, chairs, or to other objects in the room, such as glasses, a pistol or a razor (should these constitute important points in the case), saves greatly, in many cases, the time of the court. But though the drawing may be rough, remember it must be correct, or it is worse than useless.

We repeat:—let your mind, before you enter the witness-box, be clear on all dates, times, distances, size, measurement of objects, etc., on which you are about to give evidence, lest you confuse rather than help justice.

(γ.) Again, as an expert, you will be called upon for opinions. The conclusions you would draw from the facts proved, demand your most careful and studious consideration. The medico-legal opinion of any value is the thoughtful, oftentimes tedious, work of the study, and not that (as we may say) jumped at on the spur of the moment under examination. And if in the quiet of your study you fail to come to a satisfactory conclusion, do not attempt a wild conjecture (I beseech you) in the hurry and excitement of the witness-box. To *be* accurate, is ten thousand times better than to *appear* brilliant. Read over and carefully study the subject-matter of your evidence as stated by authorities. Carefully consider the opinions held and taught by others, and the precise grounds on which they hold and teach them. I do not say that the opinion of an authority, however great, is to convince you against your reason; but I do say, that it is your duty respectfully to consider it with a mind fully open to conviction. Want of thought (laziness in fact) is a far worse crime than error of judgment.

Further, on matters of opinion, assuming your own opinion to be correct, it is manifestly unfair to an inculpated person to state it as if there were no other, when professional men of admitted eminence hold an opposite view.

And here let me suggest that in your quiet preparation for the witness-box, you should regard yourself as prompting counsel for your own cross-examination (playing the part, as has been wittily said, of devil's advocate). This is indeed the only safe course. Never for an instant allow yourself to imagine that counsel on the other side will be imperfectly instructed, or ignorant of the views of standard authorities. Do not, therefore, be blind to the difficulties of your case, lest they come upon you unawares, and your eyes be opened at an inconvenient season. Rather to yourself exaggerate the difficulties of your own side, and carefully consider how you will meet and explain them when the time comes. And so your preparation on this head should be of a dual nature; *first*, a careful study of the opinions held and expressed by authorities; and *secondly*, your reasons for accepting certain opinions and for rejecting others.

3. Before giving evidence carefully distinguish between facts and opinions. That prussic acid and belladonna are deadly poisons are facts, but their precise method of action are matters of opinion. The

direction of a wound in the throat and its size are matters of fact, but the deduction that the wound in question was inflicted by a left-handed person, or that it was homicidal and not suicidal, or *vice versâ*, will in most cases be matters of opinion. Facts, of course, hold a very different position in evidence to the opinions of experts, no matter how distinguished the experts. And as regards opinions, remember this, they must be formed on facts known personally to yourself, or proved in evidence, and not from hearsay and public rumor.

Once more, carefully distinguish between your duty as a witness and the duty of the jury. As I have already pointed out, the witness must never attempt to arrogate to himself the functions of the jury. Difficult as oftentimes this task is, the good sense of the medical jurist will in most cases dictate the line that he must not pass.

4. In giving evidence, use at all times when possible plain English:—at any rate never attempt quotations (as if to appear learned) in foreign languages. A "blood clot" is a better witness-box phrase than "an apoplectic extravasation." Speak of "a bruise" rather than of "a contusion," of "the belly" rather than "the abdomen." Avoid exaggerated expressions. Avoid, too, all flippancy of manner. I do not say assume any absurd air of preternatural gravity, but be natural. Take care before you answer a question, that you both hear and understand it, and then answer it so that you can be heard and understood. Avoid as far as possible all prolixity and useless repetitions. Avoid giving answers qualified by "ifs" and provided "thats," and so on. If you, knowing all the medical details, are uncertain in your own mind, how can a jury decide who only know what you tell them? I do not mean that you are to speak positively when you are unable to do so, but simply this, that if you are unable to make up your mind definitely on matters of opinion, it is infinitely better not to attempt an opinion in the witness-box at all. And above all, frame your answer so that it conveys your real meaning, and take care, if any doubt as to its meaning exists in the mind of the judge, that you do not pass it over until the obscurity has been cleared up.

5. In stating conversations you have had with a prisoner, or with others in the presence of a prisoner, judges prefer that the precise words of the conversation should be stated. Thus, instead of saying "I asked the prisoner whether he knew anything about the murder, but he denied doing so," it is better to state it thus: "I said to the prisoner, 'Do you know anything about this murder?' to which he replied, 'No, I know nothing whatever about it.'"

6. In cross-examination never lose your temper. Your best de-

fence, if unfairly pressed, is perfect coolness. The honest witness can afford to be dignified.

7. If you are asked a question you cannot answer, at once admit it, with a plain outspoken "I don't know." Nothing is more dangerous than for a witness to attempt a guess for fear of being thought ignorant. For a manufactured answer suggests further questions, until at last the witness finds himself in a maze from which extrication is well-nigh hopeless. It is absurd to suppose that an individual, however accomplished, can answer every question and unravel every difficulty that can be invented by a skilful cross-examiner, whose life has been spent in framing questions and in manufacturing difficulties. Nothing baffles a troublesome counsel more completely than the plain "I don't know" of an honest witness. It is difficult enough at times to answer a scientific question, framed with scientific precision, but it is often well-nigh hopeless to answer scientific questions, asked with the want of precision of the unscientific counsel.

8. But having once replied "I don't know" to a question, never allow yourself to be further drawn out by the skill of counsel. For instance, you may be asked—"How long in your opinion was a certain wound inflicted before your attention was called to it?" to which you answer (and in many cases very properly) "I don't know." Take care that is your ultimatum,—for the next question you may be asked is "Do you think it was a month before?" and should you be tempted to say "Yes," the next question is certain to be, "Was it a fortnight?" and the next, "Was it a week?" and so on, until your original "I don't know" appears, to say the least, ridiculous. In all such systems of cross-examination remind counsel at once of your original answer.

9. There are certain cases where counsel may compel you to say "Yes" or "No" to a question. Having done so, however, you have then a right to insist upon giving any explanation you see fit. And seeing how practically impossible it is at times to answer a question with a plain "Yes" or "No," a witness should always, if circumstances require it, insist on his right in this respect, lest his answer convey a wrong impression.

I cannot do better in conclusion than quote the sensible, manly advice given by Sir William Blizard (a former surgeon of this hospital) to his pupils. He said—"Be the plainest men in the world in a court of justice. Never harbor a thought that if you do not appear positive you must appear little and mean. Give your evidence in as concise, plain, and yet clear a manner as possible. Be intelligent, candid, and just, but never aim at appearing unnecessarily scientific. State all the

sources from and by which you have gained your information. If you can, make your evidence a self-evident truth. Thus, though the court may at the time have too good or too mean an opinion of your judgment, they must deem you an honest man. Never be dogmatic, or set yourselves up for judge and jury. Take no side whatever, but be impartial, and you will be honest."

[*The foregoing Lecture, introductory to the Course of Forensic Medicine, was delivered in substance at the London Hospital Medical College, May,* 1881.]

CHAPTER II.

THE SIGNS OF DEATH.

Definition of Death—The Cessation of Circulation and Respiration—Insensibility and Loss of Power—Effects of Flame on the Skin and other Minor Signs of Death—Changes in and about the Eye—Changes of Temperature—Muscular Flaccidity and Irritability—Rigor Mortis—Cadaveric Ecchymoses or Lividities—Putrefaction—Adipocere—Mummification.

(ILLUSTRATIVE CASES, PAGE 102.)

DEATH may be defined either popularly or scientifically.

During life the loss of tissue consequent on work actually performed, is compensated by the formation of new tissue similar in character, and within a little alike in quantity, to that destroyed. This ever-recurring destruction and reparation of tissue, constitutes the business of the animal or vital functions. In youth the formation of tissue proceeds more rapidly than its destruction:—hence arises growth. As age advances the work of reparation declines. Death is the actual cessation of the process of reparation—the inertia of all that was capable of motion under the *régime* of life.

The cessation of the vital functions, and of the general renewal of tissue consequent on that cessation, is termed *Somatic Death*, *i.e.*, the death of the body as a whole. The actual moment of its occurrence can be more or less precisely determined by the stoppage of circulation and respiration.

But there may be the death of a part, tissue or organ, without the general stoppage of the circulation. The part thus affected becomes obedient to the operation of the ordinary chemical and physical agencies governing the inorganic molecule. This is termed *Molecular Death*. Molecular death may be either *partial* or *complete*. If only partial, it may, or it may not, spread to the organism as a whole:—in other words, the weakness in one part of the machinery, may throw, or may fail to throw, the whole working out of gear. As a rule, the action required to bring about complete molecular death (*i.e.*, the suspension of vital activity in every part) is progressive. In a given case, there-

fore, we are unable to state any definite time as *the* period of its occurrence. After somatic death it is certain that a considerable degree of molecular life may manifest itself, such as epidermic fecundity (evidenced by a growth of the hair and nails), and occasionally, acts of nutrition and secretion.

Complete molecular death is the true scientific death of the body. From it efforts at resuscitation are unavailing, and the precise moment of its occurrence is not recognizable. *Somatic death* is the popular idea of death. From it efforts at resuscitation, under exceptional circumstances, succeed, whilst in most cases the time when it takes place can be more or less accurately defined.[1]

Two points occur for our consideration:

First.—*The signs of the reality of death.*

Secondly.—*The indications by which, in any given case, the medical jurist may form an opinion as to the period that life has been extinct.*

We are far from denying the possibility of apparent death being mistaken for real death (*Cases* 55 to 57);[2] but we are equally unprepared to admit that such a mistake is likely to occur, in this country at least, to a cautious observer, after careful examination with the instruments that modern science has placed within his reach. (*Case* 70.) Hence, whatever *may* have happened, modern stories of premature burial in England, belong to the domain of the novelist rather than of the scientist. Further, the signs of death are, for the most part, as certain and as definite after a few hours' suspension of the vital functions, as they are after many days. ("*Med. Times and Gazette,*" May 22, 1875, p. 559.) But granting this to be true in temperate climates such as our own, it would appear that the difficulties of diagnosis are greater in some others, and that to mistake the living for the dead, is not so uncommon an error as might at first be supposed. ("*Med. Times and Gazette,*" May 10, 1879, p. 515.)

Professor Nussbaum, of Munich ("*Journ. de Med. de Bruxelles,*" Feb. 7, 1871), states that he believes many to have been buried during the war that were not really dead, but merely suffering from an ex-

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[1] In a communication to the French Academy, Professor Fort mentions a child (æt. 8) having been resuscitated by artificial respiration continued for four hours, and not commenced until three and a-half hours after its apparent decease; also a second case of drowning, where Dr. Fournol kept up artificial respiration for four hours with a successful result, although it was not commenced until one hour after the patient had been removed from the water apparently lifeless (?).

[2] Ogston records one case of a child alive for seven hours, and a second case of a young woman alive for four hours after they had been left as dead.

treme lethargy arising from loss of blood, exhaustion, hunger, cold, and fear.

The opinion of the physician as to the reality of a death may be sought under the following circumstances:—

1. Where the person has directed by will that before being finally "screwed down" he shall be certified by a competent authority to be dead. ("*Med. Press and Circular*," 1879, I., p. 492.)

2. Where, owing to certain exceptional occurrences, such as post-mortem hemorrhages, the turning of a body in the coffin, and other effects resulting from the development of the gases of putrefaction—or to the slowness with which from accidental causes putrefaction may develop itself—or to the unaltered and life-like condition of the face and countenance not infrequent after certain forms of death—or to the retardation of post-mortem cooling (*Case* 71), a medical opinion confirmatory of the reality of the death is sought by the relatives.

3. Where, in cases of succession to titles or large property, the relatives require a certificate of the reality of the death.

4. And lastly, cases arise where, a dead body being found, the opinion of the medical jurist is sought as to the interval that has elapsed since death.

One general remark of caution is suggested here. No physician is justified in certifying a person to be dead unless the majority of the signs of death are well marked; in other words, he should never be satisfied that life is extinct from one or two appearances merely.

It will be convenient first of all to consider the data, as a whole, upon which our answers to these two questions—viz. (1), the reality of the death, and (2) the time of death—must be based. Having considered these in detail, we shall then discuss how far we are warranted in returning definite replies to the questions, and what are the limits of our exact knowledge on the subject.

We shall discuss the signs of death in the following order:—

I.—The entire and continuous cessation of the heart's action.

II.—The entire and continuous cessation of respiration.

III.—Insensibility, and the inability to move.

IV.—Certain minor signs of death, viz.:—

(α.) Effects of flame and heat on the skin.
(β.) Action of caustic.
(γ.) Changes in the face and countenance.
(δ.) Position of the hands.
(ε.) Transparency of the hands,
(ζ.) The odor of death.

V.—Changes in and about the eye.
VI.—Changes in temperature.
VII.—Changes in the muscles and in the general condition of the body. These will be considered under the following heads:—
A. The period of muscular flaccidity and contractility.
B. The period of rigor mortis or cadaveric rigidity.
C. The period dating from the commencement of putrefaction.
VIII.—The formation of adipocere.
IX.—Mummification.

I.—The entire and continuous cessation of the heart's action.—No certain opinion respecting the cessation of circulation can be formed in any case from the mere absence of pulse, *i.e*, of the stroke communicated to the finger by a more or less superficial artery. For an absence of pulse may occur in many diseases, such as cholera, abdominal collapse, shock, etc.

The noise produced by the heart under the ordinary conditions of health may be resolved into two sounds, commonly represented by the syllables lŭbb-dŭp, lŭbb-dŭp, etc. The first sound, which is coincident with the contraction of the ventricles (*systolic*), is longer and of lower pitch than the second, which is coincident with the closure of the semilunar valves (*diastolic*). These sounds are separated by short, but appreciable intervals of silence, a longer pause intervening between the second sound and the recurrence of the first, than between the end of the first sound and the commencement of the second.

But the noise of the heart may be *abnormal*. Thus the first sound may be extremely short or even inaudible, a condition that may occur in cases of great weakness. Or again, a blowing sound (*bruit*), as in cases of valvular disease, etc., may replace one or both sounds.

The medical jurist, in determining the reality of death, therefore, must convince himself not only of the *entire cessation*, but of the *continuous cessation*, of the action of the heart. For the heart may seem to cease for a time, yet after a brief interval recommence action. (*Cases* 58 and 65.) To decide the absolute absence of all cardiac sounds, auscultation and palpation, in a perfectly quiet room, are necessary. And this examination must include not merely the region of the heart proper, but of the chest generally, remembering that both the *position* and the *sounds* of the heart may be abnormal. Again, that this absence of cardiac sounds is *continuous*, and not merely acci-

dental, should be determined by careful auscultation for two or three hours, at intervals of fifteen minutes.

There can be no doubt that recovery has taken place after the heart has (at any rate) apparently ceased beating for a quarter of an hour. In the case of children, efficient means have succeeded in restoring vitality, where for fifteen or thirty minutes after birth no pulsations could be detected. *Case* 58 is one of a similar nature, recorded as having occurred in an adult. There may be cases, again, of syncope, or of coma from intoxication, where the action of the heart is for all practical purposes imperceptible, although there is reasonable doubt whether, under favorable conditions, even in such cases, the heart-beats are not always to be detected by an experienced auscultator. (*See* M. Bouchut's experiments.) During the condition of hybernation, it has been shown that vital energy is greatly reduced. Thus in the marmot, the beats of the heart, which under ordinary conditions range from 80 to 90 per minute, sink during hybernation to 8 or 9 (*M. Bouchut*). The cases recorded of profound sleep or trance (a kind of human hybernation), occurring more especially in girls, but by no means confined to them, show how slow and feeble the heart's action, consistent with life, may become. (*Cases* 59, 64, 65.) Still, in an extreme illustration of this nature on record (*Case* 63), where every vital function seemed interfered with, the case presenting a condition almost of cadaveric rigidity *minus* death, the beats of the heart could nevertheless be detected, and constituted practically the only test of life. (*See* also *Case* 60.)

Again, the possibility of a voluntary suspension of the heart's action must not be overlooked. The case of the Hon. Colonel Townshend supplies us with a curiously instructive illustration of how careful observers (remembering that at this time the stethoscope had not been invented) may be deceived by conditions simulating death:—

"He told us he had sent for us to give him some account of an odd sensation he had for some time observed and felt in himself; which was, that composing himself, he could die or expire when he pleased, and yet, by an effort, or somehow, he could come to life again; which, it seems, he had sometimes tried before he had sent for us. We all three felt his pulse first; it was distinct, though small and thready, and his heart had its usual beating. He composed himself on his back, and lay in a still posture some time. While I held his right hand, Dr. Baynard laid his hand on his heart, and Mr. Skrine held a clean looking-glass to his mouth. I found his pulse sink gradually, till at last I could not feel any by the most exact and nice touch. Dr. Baynard could not feel the least motion in his heart, nor Mr. Skrine discern the least soil of breath on the bright mirror he held to his

mouth. Then each of us by turns examined his arm, heart, and breath, but could not by the nicest scrutiny discover the least symptom of life in him. This continued about half an hour. As we were going away (thinking him dead) we observed some motion about the body, and upon examination found his pulse and the motion of his heart gradually returning; he began to breathe gently, and speak softly. This experiment was made in the morning, and he died in the evening. On opening the body nothing was discovered but disease of the kidney, for which he had long been under medical treatment, all the other viscera being perfectly sound." (*Cheyne's* "*Treatise on Nervous Diseases*," p. 307.)

It would seem, from records well attested, that certain Indian Fakeers are able to hold their breath and pass into a state of trance, during which the heart's sounds become inaudible. (*See Braid on* "*Trance and Human Hybernation.*")

In addition to palpation and auscultation, certain mechanical tests (first suggested by Dr. Balfour), are worth notice. To detect fine chest movements, Dr. Balfour proposed sticking needles (having little paper flags fixed on their blunt ends) into the skin. Dr. Sansom suggests, as preferable, small pieces of cotton-wool drawn out into finely pointed cones of about two inches in length. These are to be attached by their base to the skin with a little unguent or cold cream, and distributed over the vessels of the neck and the region of the heart, more especially its apex and right ventricle. The room must be kept perfectly still and free from draughts during the time that the observations are being conducted. The slightest movement of the chest wall will now be evident, and amplified by the length of the cotton-wool lever. Of course this at best is only a positive test. Given no visible movements, death is by no means necessarily indicated, inasmuch as cases occur during life where no external movements of the chest are manifest. The cardiograph for this purpose is useless, for even with a fairly active heart, under many conditions, such as when the heart is covered by lung, its indications are but slight.

We need merely mention the far-fetched and impracticable test of Foubert, viz., cutting through one of the intercostal spaces and feeling the heart with the point of the finger (!).

There are several other tests of death that have been suggested, the rationale of which depend on the stoppage of the circulation. These may be mentioned here ("*London Med. Record*," 1874, p. 226):—

1. "If a limb of the body (a finger being the most convenient unless the hand be very horny, when the lobe of the ear may be operated

upon) be tightly bound round with a ligature, the part beyond the constriction will, if the person be living, become bright red, the tint increasing in depth until it finally assumes a uniformly bluish-red color. At the spot, however, where the ligature is applied, a narrow white ring becomes visible. No change results from the application of the ligature after death." (*Dr. Magnus*, "*Virchow Archiv.*," Oct., 1872.)

2. "If, after life has been extinct *for some hours*, a scarificator and cupping glass be applied, no blood flows." (*M. Levasseur*, Hôtel Dieu.) It is to be remarked that in *Case* 32, certain wounds, inflicted during life, bled some days (perhaps as many as eight) after death.

3. "If, during life, clean and bright needles be thrust into the muscles, the steel rapidly rusts or tarnishes (oxidizes). After death no such oxidation change takes place, although the needles may remain in the flesh for an hour." (*M. Laborde, in paper before Paris Academy of Medicine*, July 26, 1870.) Much depends, however, in the results obtained by this test, on the extent to which the body has cooled.

4. It has been proposed in doubtful cases to cut down on an artery (say the temporal), to ascertain its color and contents. "After death the arteries are pale or yellowish, and empty of blood, whilst during life the vessel pulsates, and has the color of the surrounding tissues." (*Dr. Leon Davis.*) There are, however, exceptions to this (as we admit) general rule, more especially where the arteries have become rigid.

5. "If, during life, a little ammonia solution be injected subcutaneously, a port wine congestion is set up in the surrounding parts, no such redness resulting when the operation is performed on a dead body." (*M. Monteverde de Cremoni.*) This is no doubt the case after death for some hours, but it is not always true within a short time of death. Possibly degrees of congestion produced by the ammonia may roughly indicate how long life has been extinct.

Although the fact of death is to be determined, as we have said, by no single sign, but by a combination of several tests, the entire and the continuous cessation of the heart's action undoubtedly ranks first in importance. For the heart, and especially the right auricle has a life, it would seem, of its own (*ultimum moriens*) that is, a life distinct from the great nervous centres, continuing to beat and to contract a few minutes (possibly four or five minutes) after the cessation of respiration, after its removal from the body, and even after it has been cut into fragments. Duval records having seen the heart of a criminal beat for fifteen minutes after decapitation, the left auricle pulsating more or less for an hour. ("*Prov. Med. Jour.*," Sept., 1851.) A still more remarkable case of this nature is recorded by Dr. Rawitz, of

Berlin, in the case of an embryo discharged in the membranes, and measuring 3½ inches. ("*Archiv. für Anat. Physiol.*," 1879, p. 69.) The beats of the heart were observed before the sternum was removed, and the pulsations, he states, continued for four hours after the pericardium was exposed.

That vitality can be restored after the heart has absolutely ceased work for thirty minutes, is, we believe, beyond doubt impossible. The practical question, however, is not so much this, as—May not the action of the heart be so feeble that even an experienced auscultator may fail to detect it?

2.—The entire and continuous cessation of respiration.—Breathing being a vital act, any long suspension of this function must prove fatal. The time that people can "hold their breath" varies greatly, but three minutes and a half may be taken as a maximum. This, however, refers only to the *absolute* and *voluntary* cessation of breathing. To commit suicide by holding one's breath is a practical impossibility. It is certain that life may be prolonged considerably beyond three and a half minutes when the stoppage is involuntary, or when the slightest attempt at respiration, however slow and shallow, is made. (*Cases* 59, 63.)

The cessation of respiration may be more or less accurately determined by several popular tests. Of these may be mentioned:—

(1.) *By holding a looking-glass over the mouth and nose.*—Moisture is a constant constituent of the breath. If the merest trace of moisture be exhaled, it will be rendered perceptible by condensing on, and dulling the mirror. But the presence of moisture on the glass is a far more valuable indication of life, than its absence is of death. Thus a mirror placed over the mouth of animals in a state of hybernation is not dulled. In Case 64, the mirror was said to have shown no signs of condensed moisture when held over the mouth, and the same absence of dulling was also remarked in Colonel Townshend's case (page 28).

(2.) *By suspending a feather or other light body near the mouth or nose.*—The absence of any movements of the feather may be regarded as indicative of the absence of breathing. But here again care is required in drawing conclusions. Dr. Marshall Hall's "Bat" (an instrument of great delicacy employed by him for the detection of minute air-currents) was not disturbed by the breathing of hybernating animals.

(3.) *By standing a glass of water (or better still, of mercury) on the chest.*—By this means the slightest motion of the chest-walls, such

as occurs even with the faintest respirations, will be indicated by the rippling on the surface of the water, or by the movements of a reflected image (such as a candle-flame) from the surface of the mercury. The absence of such movements indicates the absence of any motion of the chest-walls, and the probable stoppage, therefore, of respiration.

These three popular tests are good in their way, their positive being in each case of far greater value than their negative results. But the medical attendant will of course fall back on careful auscultation. Nevertheless it must not be overlooked that it is consistent with life that, for a short time, respiration may for all practical purposes be imperceptible. (*Cases* 59, 63, 64.) *For a short time*, we say; hence the test of death is not merely the *entire* stoppage, but the *entire* and *continuous* stoppage, of respiration.

There is a form of breathing known as the "Cheyne-Stokes respiration" that might be important medico-legally, but which at any rate suggests the remark, that the stethoscopic examination, in cases where the existence of life has to be determined, must be something more than the mere application of a stethoscope to the chest for a few seconds. The patient in such a case might seem, when first examined, to be scarcely breathing at all. Each succeeding inspiration, however, becomes a little deeper until a maximum is reached; after this each breath that follows becomes more and more shallow, until at last the breathing seems to cease altogether. After a few seconds a feeble respiration may be taken, followed by others, each a little stronger than the one preceding it, until again a maximum is reached. Such a series of respirations (occurring occasionally in certain cardiac and cerebral diseases, in fevers, tubercular affections, etc.), might deceive an incautious observer. The period however between maximum inspirations scarcely ever exceeds two minutes, and is rarely so long. Hence it is scarcely possible for this condition to prove a serious source of error unless the examination be hurried.

Bearing on the subject of respiration, we may note that the blood taken from a dead body, provided access of air to it be prevented, exhibits the spectrum of reduced hæmoglobin only. This spectroscopic appearance of blood under the conditions mentioned was at one time supposed to be characteristic of death by asphyxia. Still there are many exceptions to this general rule, *e.g.*, in carbonic oxide poisoning (where the blood shows the spectrum peculiar to carbonic oxide hæmoglobin); also after death from cold and starvation (where the reducing power of the tissues is much diminished); and, lastly, in those cases where the entrance of air into the veins has proved the immediate cause of death.

3.—Insensibility and the loss of power to move.—Not only does insensibility and inability to move often precede death, but they are conditions that not infrequently occur without resulting in death. Such cases deserve notice:—

(1.) *Asphyxia.*—Life in cases of asphyxia (judged by the three signs of respiration, circulation, and insensibility) may be for a certain time almost unrecognizable.

(2.) *Syncope.*—A long faint may prove deceptive. Fresh air, cold water, and ammonia to the nostrils, effect, however, rapid restoration.

(3.) *Apoplexy.*

(4.) *Trance—Catalepsy—The Mesmeric State—Cases of long persistent Sleep.*—A case is recorded of a woman in a state of trance having been buried alive, the medical man and the mayor of the place who authorized the interment, being punished for having committed "involuntary manslaughter." (*Case* 57.) *Cases* 59 to 65 are illustrations of how in the cataleptic condition the vital functions may be reduced to the lowest possible ebb. Thus a remarkable fall in the temperature (*Cases* 61 and 64), insensibility to external influences, even the application of the fingers to the glottis (*Cases* 63 and 65), an almost entire stoppage, so far as physical signs would indicate, of the action of the heart and lungs (*Cases* 64 and 65), and in some cases even muscular rigidity (*Cases* 63 and 64), have been recorded. As a matter of fact, it would seem that "human hybernation" is more than a mere name. (*Cases* 59, 60.) Nevertheless in all these cases some one or more well-marked symptoms of vitality presented themselves, so that at most the difficulty was of comparatively short duration.

[*See* a series of cases mentioned under *Case* 65. *See* also "*London Med. Rec.*," 1879, p. 244, article on "Epileptic Sleep"; Lecture by Dr. Russell, of Birmingham, on "Sleep, Epilepsy, and Somnambulism," in the "*Med. Times and Gazette*," 1870, II., p. 90; "*British Med. Journ.*," 1880, II., p. 381, "Sleep and Hypnotism," by Professor W. Preyer, of Jena. *See* also an article in "Nature" on Preyer's paper, by Mr. Romanes.]

4.—There are **certain minor signs of death** which we may with advantage consider here:—

(*a.*) *The application of heat to the skin.*—This may be effected either by dropping melted sealing-wax upon it ("*Lancet*," 1876, I., 562), or by applying a candle flame until a vesicle forms (M. Martinot), ("*Brit. Med. Journ.*," April 25, 1868), or (as Dr. Sansom has suggested), by inserting a needle for a quarter of an inch through the skin into a muscle, and heating the part protruding with a spirit lamp.

We shall discuss hereafter under "Burns" (*see* Index) the exact importance to be attached to the formation of vesicles resulting from the application of heat, and the characteristics, under various modifying conditions, of the vesicles produced before and after death. This much may be stated here:—

1. If a blister on the skin, produced by the application of a flame, contains a serum rich in albumen, whilst the cutis vera, after the cuticle has been removed, presents a reddened appearance, more especially if, after a short interval, a deeply injected red line forms around the blister, absolute evidence is afforded of the vitality of the part to which the heat was applied, and exceedingly strong confirmatory evidence of the life of the person.

2. If a blister, formed by the application of flame to the body, contains air, or a little non-albuminous serum merely, the cutis vera after the removal of the cuticle appearing dry and glazed—more especially if, after an interval, no red line becomes visible around the blister, the evidence is absolute that the part so treated was dead, whilst the presumption is strong that the person himself was dead.

(β.) *The results of the application of Caustic.*—"If caustic be applied to the skin of the really dead, either no eschar is produced, or the skin turns yellow and transparent; but if it be applied to living skin, the eschar formed is of a black or reddish brown color." (M. Pryrand, of Libourne, "*Rev. Méd.*," Nov. 20, 1880.)

(γ.) *Changes in the face and countenance.*—During the after-death period of muscular relaxation, a more than usually placid expression, with marked pallor, is frequently observed (*Case* 70), whilst a drawn, contracted, painful expression with reddened countenance may be occasionally remarked after death.

What is termed the "Facies Hippocratica" (that is, a peculiar sharpness of nose and chin, flaccidity and paleness of lips, sunken eyes, hollow temples, prominent cheek-bones, dryness of the forehead, wrinkled brow, and livid skin) is found after death *during the period of relaxation only*; but it is important to note that this condition may not only be absent after death (as, *e.g.*, when the death is sudden, or the result of acute disease), but that it is occasionally well marked during life.

The cause of death has much to do with the features after death. Thus army surgeons have remarked that the mere expression of the dead on the field of battle will often reveal the cause of death, the features being said to be indicative of repose after death by sword wounds, but of pain after death by the bullet.

Undoubtedly the countenance may alter so rapidly after death, that

identification, even by those who knew the person well during life, becomes impossible.

(δ.) *Position of the hands.*—After death the fingers and thumbs become more or less flexed. Generally the thumbs bend across the palms, and the fingers over them. Whether, however, this takes place at death, or is merely an incipient sign of rigidity, is an open question. ("*Ann. d'Hyg.*," 1830, II., 420.)

(ε.) If the hand after death be examined by transmitted light it appears marble-like and opaque, whilst during life it is transparent and rosy. (Dr. Carrière, of St. Jean du Gard, "*Edin. Med. Jour.*," XV., p. 470.)

(ζ.) Many observers have spoken of a peculiar musk odor developed at the time of, and sometimes before, death. (*See* Dr. Isham, "*Amer. Journ. Med. Science*," 1881, I., p. 430.)

5.—Changes in and about the eye.—Some of these changes occur synchronously with death, whilst others set in after a greater or less interval. Of these may be noted:—

(α.) *Changes in the iris, more particularly its loss of sensibility to light:*—in other words, the inability of the pupil to contract or dilate, according to the amount of light thrown upon it.

This loss of the sensibility of the eye to light is best determined by what ophthalmic surgeons call "oblique illumination," that is, by placing a bright light on one side of the eye, in such a position that by means of a double convex lens the focus of the light may be concentrated on the pupil. By rapidly shifting the focus alternately on or off the pupillary aperture, the operator may note with great precision the contractile power of the iris under different degrees of illumination. Still it must be remembered that many cases of disease and of long persistent sleep are recorded, where complete insensibility of the pupil to light existed. (*Cases* 60 and 64.) It must not be forgotten that during life different eyes have very different degrees of contractility, and moreover that the action of certain poisons (such as calabar bean, duboisin, atropine, alcohol, etc.), and of certain diseased conditions of the eye where adhesions of the iris occur (more particularly if of old standing) materially affect the mobile power of the iris.

The action of atropine and of other bodies to produce dilatation of the pupil (*M. Dupont*), and of calabar bean to effect contraction (*Dr. Fleming*), cease with life. It has been suggested, therefore, to test the reality of death by noting the effect on the pupil of a solution of atropine, or, better still, of duboisin. Although it is undoubtedly true that these bodies have no action on the iris after life has been extinct

for some time, it is by no means necessarily so, in the case of a body that has been dead for a few hours only. Thus it has been shown that the pupil of a rabbit which died from natural causes, contracted permanently an hour after death, to one-fourth its size, from the application of two drops of an aqueous solution of physostigmia. ("*Chemical News*," 1864, I., p. 109; "*New York Med. Journ.*," IX., p. 654; "*Lancet*," 1873, I., p. 654.) I have myself seen on several occasions both atropine and physostigmia produce marked effects on the eye in the human subject half-an-hour after death.

Again, admitting that an absence of action arising from the application of electrical and mechanical stimuli is strongly indicative of death, nevertheless it is certain that they may affect the eye for a considerable period after life is extinct.

After death the iris becomes more or less flaccid. Thus during life the circular shape of the pupil is uninfluenced by external pressure, except so long as the pressure is actually applied. But after life is extinct (as M. Ripault first pointed out), external pressure is capable of permanently affecting the normal roundness of the pupillary aperture. Thus by synchronous compression of the globe in two opposite directions, the pupil in real death may be made to assume an oval or an irregular shape. [*See* letters in "*British Med. Journ.*," September 25, 1880, p. 507 (Dr. Boyd Joll), and October 9, 1880, p. 580 (Dr. Joseph W. Hunt). The latter states that this test is unreliable, as it occurs in certain cases during life, of which he quotes three instances. In one case the iris was flaccid although the patient ultimately recovered, and in two others flaccidity was noted some hours before death actually occurred. See also a letter by Mr. J. Farrant Fry, October 30, 1880, p. 728, to the same effect.] There can be little doubt that during life a certain flaccidity of the iris occasionally exists, but never in my experience to the same extent that occurs after death.

And this flaccidity of the iris explains the dilatation of the pupils that invariably occurs after death (*Küssmaul*). I believe this post-mortem dilatation to be of such constant occurrence, that it is impossible to judge the exact state of the pupils at death, by their condition at a post-mortem conducted some days afterward.

(β.) *Loss of the Sensibility of the Cornea to Touch.*—This insensibility of the cornea, always found after death, also occurs during a certain stage of an epileptic fit, and in certain cerebral injuries.

(γ.) *Loss of the transparency of the Cornea*:—in other words *the loss of lustre in the eye.*—This loss of lustre, as a rule, sets in speedily after death. It depends, in the first instance, on the formation of a

thin film of mucus over the surface of the eye. After a time, the cornea itself becomes perceptibly milky and opaque. Finally, it loses its tension, and becomes wrinkled and sensibly flattened from the absorption of the aqueous humor.

But here it is to be observed:—

First. That the eye may lose its lustre during life. This condition has been frequently recorded as occurring several hours before death in cases of cholera. ("*Ann. d'Hyg.*," 1848, I., 104.)

Secondly. That the eye may not lose its lustre for a long time after death.—This condition has been particularly observed after death from apoplexy, and after poisoning with the oxides of carbon, cyanogen and its compounds, etc.

(δ.) *Changes in the conjunctivæ.*—Soon after death the conjunctivæ exhibit externally gray cloudy discolorations which rapidly become black. These discolorations are due either to the formation of films of mucus, or (according to M. Larcher) to cadaveric imbibition dependent on putrefactive changes. M. Larcher remarks that these external stains are closely succeeded by internal stains of a similar kind, and that "the two spots extend and approach each other, forming the segment of an ellipse." ("*Ann d'Hyg.*," 1869, I., 468.)

(ε.) *Loss of tonicity and of the elastic resistance of the eye.*—During life the eyeball is elastic and resists pressure, but after death it collapses, sinks in its socket, and becomes so flaccid and buttery, that it retains the dent or mark of any pressure to which it may be subjected. This inelastic condition of the eyeball comes on in most cases about twelve or fourteen hours after death, but sometimes sooner.

But it is to be noted (1) that there may be loss of tonicity during life. Thus the globe sinks into its socket with age, and also in various affections of the eye and of the general system, more especially in diseases accompanied by great exhaustion. On the other hand (2) the eye after death may assume a preternaturally prominent appearance, the globe being pressed forward by the development within of the gases of decomposition.

(ζ.) *Loss of the elasticity of the eyelids.*

(η.) *Changes in the ophthalmoscopic appearances.*—Although as yet observations are not sufficiently numerous to say that the ophthalmoscope may be absolutely relied upon as a test of death, there is sufficient evidence to show that its indications are valuable. (*Case* 72.) Supposing the cornea to be clear enough to allow of ophthalmoscopic examination, it is stated (*M. Poncet*) that the yellowish red of the living fundus of the eye, becomes at death of a yellowish white hue. Further, M. Bouchut records that at the moment of death the gases

normally imprisoned in the venous blood are disengaged, causing the column of blood in the vessels to be broken by beads of air or gas (pneumatosis of the veins). This beaded condition is, according to Bouchut, easily and well seen with the ophthalmoscope in the case of the retinal veins, and constitutes a certain and immediate sign of death. (Bouchut, "*Gaz. des Hôp.*," March 10, 1874.) Dr. Gayat mentions that after death the arteries and veins of the *fundus oculi* are completely emptied, not only upon the optic disc, but for a limited distance around it. Beyond this point, however, the vessels remain filled with blood. ("*Annales d'Oculistique*," Jan., 1875.)

6.—Changes in the temperature of the body.—During life the healthy body has a warmth (independently of the surrounding temperature) of from 97° to 100° Fahr. (36.1° to 37.77° C.). After death a *gradual* and a *progressive* loss of heat occurs both externally and internally, until in time the temperature of the body becomes *almost* the same as that of the medium by which it is surrounded. Post-mortem cooling, however, derives its special medico-legal importance from the fact that this loss of heat is progressive. Temperature thus becomes, in many cases, not merely a sign of death, but an indication of the time that a body has been dead. (*Case* 68.)

All observations on temperature should be thermometric. The mere application of the hand to the body, is not a sufficiently delicate test of temperature, so much depending on the relative warmth of the hand of the operator and of the body. To the cold hand of one person a body may appear warm, which to the warm hand of another might appear cold.

Again, in forensic cases both the external and the internal temperature should be recorded; the external temperature being taken in the axilla, and the internal in the mouth or rectum. The external temperature, as a rule, sinks more rapidly than the internal, the skin and solids of the body generally, being bad heat conductors. M. Réné, however, states that in new-born infants he has found the temperature in the rectum to be usually lower than that in the axilla. ("*Gaz. des Hôp.*," April 7, 1877.)

Again, the temperature should be taken at stated intervals, remembering that it is not the *absolute* temperature which is so important medico-legally, as the *progressive* and *continuous* cooling of the body.

The cooling of the body after death depends upon several causes, such as (*a*) on the *cessation of certain chemical processes* going on in the body ("*Med. Times and Gazette*," Jan. 13, 1877, p. 43, and "*Lancet*," Sept. 26, 1874, p. 466); (*b*) on *radiation*; and (*c*) on *conduction*

and *convection* by the air surrounding the corpse, and by the various substances in contact with it.

It will be convenient, in the first place, to state the general facts bearing on post-mortem cooling. These are:—

(1.) That in ordinary cases a body becomes cold in from fifteen to twenty hours after death.

(2.) That in certain cases of disease, or where the body has been freely exposed to air, draughts, etc., the cooling process may practically be complete after four to five hours, whilst in certain other exceptional diseases, or under unfavorable conditions for cooling, forty-eight hours or even three days may elapse before the body is cold.

(1.) Respecting the first statement it is right to note that Casper fixes eight to twelve hours as the ordinary period for cooling, a time which, in our judgment, is too short.

It is important to follow this cooling process from its very commencement:—

It is not at all improbable that in all cases of death there is in the first instance a slight post-mortem elevation of internal temperature, owing to the stoppage of the circulation, and to the blood being no longer cooled in its passage through the lungs. This was pointed out as long ago as 1845 in the "*Phil. Med. Exam.*" (pp. 625 and 359), where it was asserted that the maximum temperature was not reached until an hour-and-a-half after death. This post-mortem rise of temperature becomes very marked in certain diseases. Thus in deaths from yellow fever and cholera, Bright's disease (*Dr. Wilks*), abscess of the liver (*Dr. Goodhart*) and other abdominal affections (*Dr. Berinet Dowler*), rheumatic fever, small-pox ("*Lancet*," 1870, I., 21), tetanus and injuries to the nervous system generally, etc., an increase of temperature, amounting in some cases even to 9 degrees F. (4.95 degrees C.), has been observed. Dr. Davy records a post-mortem temperature of 113° F. (45° C.) in the pericardium. In Dr. Goodhart's case ("*Brit. Med. Jour.*," 1874, I.) the post-mortem rise of temperature (commencing nineteen hours after death) amounted to 4 degrees, although the atmospheric temperature during the same period had a corresponding fall of 4 degrees. Savory records that he has noticed in dogs poisoned with strychnia an after-death elevation of temperature equal to 1 to 2 degrees Fahr.

We have now to consider the time occupied by this cooling process.

The researches of Drs. Taylor and Wilks on *external* temperatures ("*Guy's Hospital Reports*," Oct., 1863, p. 184) are summarized in the

following table. The observations were made by simply placing the bulb of a thermometer on the skin of the abdomen:—

	2 to 3 hours after death.		4 to 6 hours after death.		6 to 8 hours after death.		12 hours or more after death.	
Number of observations.	76		49		29		35	
	F.	C.	F.	C.	F.	C.	F.	C.
Maximum temperature of the body........	94°	34.4°	86°	30°	80°	26.6°	79°	26.1°
Minimum temperature of the body........	60°	15.5°	62°	16.6°	60°	15.5°	56°	13.3°
Average temperature ..	77°	25°	74°	23.3°	70°	21.1°	69°	20.5°

Of *internal* temperatures, Taylor and Wilks record cases of 76° F. (24.45° C.) seventeen and eighteen hours after death, and of 85° F. (29.45° C.) ten hours after death.

Dr. Guy remarks from an analysis of the eight cases of accident in which observations are recorded by Taylor and Wilks, that (starting from the abdomen which had at death an average temperature of 83° F.) the cooling process proceeded at the rate of about 1 degree Fahr. per hour. These bodies were merely lightly covered. The cooling would necessarily be more or less rapid according to the amount of clothing on the body.

According to the observations and experiments of Messrs. Durand and Linas, eighteen to twenty-four hours is the period ordinarily required for a body to cool down to the temperature of the surrounding atmosphere.

M. Laborde states that, according to his observations, the temperature of the deeper tissues of the body sink as low as 82.4° or even 80° Fahr. (26.0° to 26.66° C.) after from five to eight hours.

Dr. Niderkorn's observations on this subject ("*De la Rigidité Cadavérique chez l'homme*," Paris, 1872) are of great interest. Respecting *external* temperatures (taken in the axilla) the following table records the average results of 135 observations made by him on the bodies of persons who had died from various diseases:—

Temperature of body after death.	2 to 4 hours.		4 to 6 hours.		6 to 8 hours.		8 to 12 hours or more.	
	F.	C.	F.	C.	F.	C.	F.	C.
Maximum	109.4°	43.0°	98.2°	36.8°	95.3°	35.2°	100.4°	37.8°
Minimum	89.6°	32.0°	80.6°	27.0°	70.5°	21.4°	62.6°	17.0°
Average	96.9°	36.1°	90.2°	32.3°	81.7°	27.6°	77.9°	25.5°

Of internal temperatures Niderkorn states, that in six cases examined from six to eight hours after death, the rectal temperature averaged 90.6° F. (32.6° C.), and that in nine cases examined from twelve to fourteen hours after death it averaged 89.2° F. (31.8° C.).

Dr. Wilkie Burman has recorded a series of observations on post-mortem cooling extending over periods varying from one to twenty-five hours after death. The results, unfortunately, are incomplete, seeing they do not embrace the entire period extending from the moment of death to the time when air and body are of identical temperatures. Thus, in one case twenty-five hours after death, the body was 19.6 degrees F. above the temperature of the room (54° F.). Assuming the temperature of the body at death to be 98.4° F. (36.8° C.), and the corpse to remain in bed with the usual coverings, Dr. Burman calculates that cooling progresses at the average rate of about 1.6 of a degree F. per hour ("*Edin. Med. Jour.*," xxv., p. 993).

But it is most important to bear in mind that the rate of cooling is not uniform. Notwithstanding the post-mortem rise of temperature, it is, on the whole, during the earlier hours after death that the most rapid cooling occurs. During the later hours, the loss per hour becomes exceedingly trifling. Thus Dr. Goodhart records two cases, one the body of a robust child, and the second that of a boy æt. 19, where the loss was no less than 8 degrees F. during the first hour.

We are indebted to Dr. Goodhart for the following table, the result of his observations on post-mortem cooling, showing the rapidity of the cooling process during the first few hours after death, compared with what takes place at later periods:—

	3 hours from time of death. Loss per hour. Degrees Fahr.	6 hours from time of death. Loss per hour. Degrees Fahr.	Body nearly cold. Loss per hour. Degrees Fahr.
In the emaciated ..	4.7	3	1.12
In the robust	3.5	3	1.26

We may here note the influence of an abnormally high body temperature at the time of death, on the after cooling. Dr. Goodhart has observed 9 cases occurring in well-conditioned as well as in emaciated subjects, where the temperature before death was over 102° F. After death the average loss per hour during the first three hours, in both emaciated and robust, was 3.37 degrees F., whilst in emaciated subjects only, the loss was 4.55 degrees F.

In fixing fifteen to twenty hours as the time ordinarily required for post-mortem cooling, it is not suggested that within that period the body becomes absolutely of the same temperature as the medium (be it air or water) in which it is placed. For this a very long time indeed may be required. Dr. Letheby, in the year 1851, showed that even so long after death as from twenty to twenty-four hours, when the surrounding atmosphere was 55° to 57° F. (12.77 to 13.89° C.), the axillary temperature would often register 14° F. (7.70° C.), and the rectal temperature 18° F. (9.92° C.) above that of the room. The same fact has been noticed by Dr. Hensley, whilst Drs. Taylor and Wilks' experiments indicate, that even after the lapse of very many hours, the heat of the body always remains a little above the temperature of the air.

Thus when we fix fifteen to twenty hours as the normal period of post-mortem cooling, we imply that within that time the temperature of the body will gradually and progressively sink very much below that which experience proves to be essential for the existence of life:—in other words, the natural warmth indicative of life will practically disappear.

(2.) We have now to consider the circumstances influencing the rapidity of cooling:—

1. *The time occupied by the process of cooling may be lengthened:*—

(*a*) In acute diseases generally—in sudden death (as from accident, apoplexy, etc.)—in all cases of asphyxia (except from drowning), the body parts with its heat slowly. Nysten states that after death from asphyxia it may require three days for the body to cool; but cases are certainly not uncommon where the process has occupied 48 hours. Cases of rapid cooling, however, in asphyxia are recorded. Thus in one which came under my own observation (Lowestoft murder case), where three children were murdered by the mother placing their heads in a pail of water, the evidence was conclusive that the bodies completely lost their natural warmth within 6.5 hours. The children were seen alive at 10 P.M., and at 4.30 A.M., when the medical man was called in, the bodies were perfectly cold. The case, however, was somewhat complicated, the children's clothes having been a good deal soddened by the submersion.

A remarkable case is recorded in the *Lancet* (*Case* 70), and a second by Ogston (*Case* 71), where some doubt as to the reality of death was felt on account of the prolonged cooling of the bodies. We scarcely follow Ogston, however, in accounting for this slow cooling by the occurrence of putrefaction, and the increased warmth resulting from the chemical changes consequent upon it.

It will suffice merely to mention other circumstances that prolong post-mortem cooling:—These are

(β.) The body being well clothed.

(γ.) Its preservation in a small and warm room, and its non-exposure to currents of cold air.

(δ.) Its being well covered, or, if in the air, the body being on a dungheap or other non-conducting material.

(ε.) *Age.*—Adults cool less rapidly than either children or the aged.

(ζ.) *Condition of body.*—The body of a fat person (fat being a very bad conductor of heat) cools far more slowly than that of a lean one.

2. *The time occupied by the process of cooling may be shortened:*—

(α.) In death from chronic diseases, where there has been great wasting (phthisis, cancer, œsophageal disease, etc.)—in cholera—after great losses of blood (Dr. Richardson, "*Medical Critic*," Jan., 1863, p. 370), etc., the body usually cools rapidly—so rapidly indeed that within four or five hours its external temperature may be almost identical with that of the surrounding medium.

Dr. Taylor has shown, however, that loss of blood does not invariably cause rapid cooling. Thus he records the case of a man (æt. 48) who died from hemorrhage, the temperature of whose abdomen four hours after death was 84° F. (28.89° C.), and eight hours after death 80° F. (26.66° C.), the temperature of the dead-house being only 38° F. (3.3° C.). It is, however, noteworthy that the man had met with an accident necessitating ligature of the axillary artery. (*See Case* 69.)

It is worth noting that in the recorded cases of rapid cooling, an extreme coldness of exposed parts (such as of the hands, feet, nose, ears, etc.) commonly manifested itself during the last hours of life.

Of other causes of rapid cooling may be mentioned:—

(β.) The body being exposed to air and to cold draughts in a more or less uncovered state.

(γ.) The size of the apartment where the body lies, cooling being more rapid in a large and draughty room, than in a small warm one.

(δ.) Its exposure to the air on the floor or other good conducting surface.

(ε.) *Age.*—The bodies of children and of old persons cool more rapidly than those of adults.

(ζ.) *Condition of body.*—The bodies of lean people cool more rapidly than those of stout.

(η.) Death from drowning—the temperature of water on any given day being always considerably below that of the air.

We may conclude these remarks on temperature by one practical observation—However suggestive of the cause of death, the *rapid* after-death cooling of a body may be, it is certain that no conclusion can be drawn from the *slow* cooling of a body. (*See* "*British Med. Journal*," 1874, I., pp. 125, 153, 303, 408.) Regarding the whole subject from this point of view, we conclude (1), that, knowing the cause of death in any given case, it is not possible to predict with any certainty the probable rate of cooling; and conversely (2), that from the rate of cooling, we are not justified in drawing a positive conclusion as to the cause of death.

7.—Changes in the muscles and in the general condition of the body after death.—We may distinguish three post-mortem periods or stages, marked severally by very different conditions or states of the body. These three stages furnish data by which to determine in any given case the period that has probably elapsed since death, and are forensically in all their details of the very utmost importance.

First Stage (A).—Within a short time after death the muscles become flaccid. This shows itself by the dropped jaw, the loss of tonicity in the eyelids, the flexibility of the joints, and the flabbiness of the limbs. During this period, however, the flabby muscles are capable of contracting under the application of stimuli, such as the interrupted electric current, blows, etc. We may term this period therefore

The stage of muscular flaccidity and contractility.

Second Stage (B).—When flaccidity and irritability cease, the muscles become stiff and rigid. We term this

The stage of cadaveric rigidity (*rigor mortis*).

Third Stage (C).—As soon as the rigor mortis ceases, or, more properly we should say, synchronously with the disappearance of the rigor mortis, putrefaction sets in. This third period is

The stage of putrefaction.

Although chronologically inaccurate, because in the time of appearance belonging to the first stage, we shall for convenience consider under this head the subject of "*Cadaveric Lividities.*"

First Stage (A).

The period of muscular flaccidity and contractility.

This constitutes the first stage after death. The period of muscular softness (not to be confounded with the cadaveric softening that *follows* rigidity), includes the interval between death and the commencement of rigor mortis. Commonly with death there ensues complete muscular relaxation. This occurs even after severe tetanus, the jaw becoming unlocked and the limbs pliant with death. As a result of this non-elasticity and softness, the parts of the body in contact with the bed or surface on which it may rest, become flattened. We shall discuss hereafter the time this condition of muscular relaxation and flaccidity with contractility continues, but we may say here that although it may occasionally occupy only a few minutes, and even be non-existent (a circumstance of great importance forensically), it more commonly lasts about three hours. There are no well attested cases, however, where this stage has been prolonged beyond twenty-four hours.[1] It is difficult to say what is the cause of this muscular softness. It may be molecular, or (what is more likely), dependent on a different distribution of the fluids in the tissues.

During this first post-mortem period, the muscles, though flaccid, are easily excited to contraction by interrupted currents, such as are produced by the ordinary "medical machine," where the keeper rotates between the poles of a magnet. In this respect the muscles during life, and during this first after-death stage, agree. In like manner, chemical irritants and mechanical excitants, such as striking a muscle with the hand, may produce similar effects. Thus Dr. Dowler (of New Orleans) states, that by a succession of slight blows he has succeeded in making a dead limb raise a heavy weight, and also perform perfect pronation, supination and flexion. ("*Experimental Researches on Post-Mortem Contractility*," by Bennet Dowler, New York, 1846, p. 601.)

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[1] The experiments of Rosenthal (Stricker's "*Med. Jahrbuch*," 1872, and "*Journal of Anat. and Phys.*," Nov., 1872) on the duration of the electrical excitability of the muscles and nerves, were conducted on twenty subjects that had died of various diseases. The stimulus used was both the continuous and interrupted currents. Rosenthal proved that the excitability of the muscles lasts longer than that of the nerves, dying out in a centrifugal direction. The orbicularis palpebrarum is, according to his observations, the last muscle of the face to lose its susceptibility. Rosenthal concludes that the absence of electrical excitability in the muscles is an unequivocal sign of complete somatic death, when the retention of other characters might render the diagnosis in some measure doubtful. He records a case where the presence of vitality was diagnosed by this means after forty-four hours of apparent death.

To test the muscular irritability of a body, two fine steel needles are to be inserted into the biceps, or (preferably) into one of the trunk muscles, an interval of about two inches being left between them. The needles are now to be connected by copper wires with an ordinary magnetic medical machine, the handle at first being worked slowly. A series of contractions will at once be noticed, if the muscular irritability be retained.

During the contraction of a muscle both *heat* and *sound* are produced. It has been suggested to record the *heat* developed during the experiment, by placing a thermometer, capable of registering at least tenths of a degree Centigrade, into the muscle. The *sound* (susurrus) produced by muscle in action (audible, for instance, if the little finger be inserted in the ear and the muscles of the ball of the thumb be vigorously worked), may be distinctly heard when the stethoscope is placed over a muscle artificially excited to contraction. As a practical fact, however, sight is the best test of muscular contractility. The thermometer is, we believe, useless, whilst movements may be detected by the eye that are unrecognizable by the ear.

The general practical conclusion respecting post-mortem muscular contractility may be thus stated:—Given the non-contractility of a muscle under an artificial stimulus, we may conclude not only the reality of the death, but that life has been extinct for some time. On the other hand, given contractility, we may conclude either that the person is alive, or at most has only been dead for a short time.

But there are several points suggested by this general statement of fact requiring further consideration :—

(1.) The contractility of a muscle by electrical and other stimuli, is no certain test of life.

(2.) The non-contractility of a muscle by electrical and other stimuli, is no certain sign of death.

(3.) Hence we inquire, If after death a muscle contracts by the passage of an electric current, what conclusions are we justified in deducing to assist us in determining the time of death?

(1.) We note then, first, that *the contractility of a muscle is no certain test of life.* As we have already said, muscular contractility continues more or less completely for some hours after death, definite movements resulting when the muscle is irritated.

A further curious question, however, arises here, viz., how far may post-mortem muscular movements occur spontaneously? One such spontaneous movement is of frequent occurrence after death, viz., raising the lower jaw. During the cholera epidemic of 1866, I repeatedly witnessed such movements several hours after the cessation of respira-

tion and circulation. In one case, muscular movements of a very marked kind, pronation, supination, and flexion, were observed seven hours after death, no artificial stimulus being employed for their production. They were, so far as one could judge, absolutely spontaneous. The same thing has been noticed after death from yellow fever, and from other diseases. It is recorded in a case of cholera, where for an hour after death spontaneous contractions and relaxations took place in the arm, that the limb became manifestly warmer. (*Mr. Rumsey.*) The occurrence of such movements have no doubt been the origin of many of the sensational stories of premature burial, such as novel-mongers delight in. Certainly, however, they may with reason prove a source of trouble to friends, although they can scarcely long deceive the physician as to the reality of the death. (See "*Dr. Bennet Dowler's Experimental Researches on Post-mortem Contractility*," New York, 1846.) Again, the continuance of muscular contractility, and the possibility of its being spontaneous, may (as has been suggested) be one explanation of those rare cases where a fœtus has been born, as it were naturally, after the death of the mother (*Case* 73), although undoubtedly it, and results of a similar kind, are more likely to be caused by the outward forcing occasioned by the development of the gases of putrefaction, than by spontaneous post-mortem muscular action. (*See* p. 72.)

(2.) But, secondly, *the non-contractility of a muscle by an interrupted current is no certain test of death.*

Under certain conditions the power of living muscle to contract by the action of stimuli, may not only be modified, but in a great measure suspended. These circumstances require notice. They are :—

(*a.*) *Exhaustion*, consequent on great fatigue, or on the long continued application of electricity. Hence it is undesirable, in cases of suspended animation, to apply galvanism for any great length of time without intermission.

(*b.*) *Certain diseases* impair and sometimes actually destroy muscular contractility. Of these, paraplegia, pseudo-hypertrophic paralysis of Duchenne, and other diseases of the brain and spinal cord, may be mentioned.

(*c.*) *Certain physical conditions*, such as trance, hysteria, shock, etc., greatly impair muscular contractility.

(*d.*) *Certain poisons.* Thus muscular contractility is materially weakened in chronic lead poisoning, and by the action of strychnia, nitrite of amyl, etc.

(*e.*) *A long continued low temperature*, such as a cold of 28° to 38°

F. suspends, without destroying, muscular irritability. (*Richardson's Croonian Lectures*, 1873.)

(*f.*) *A long continued heat of about* 12° *Fahr.* (6.6° Cent.) *above the normal temperature of the animal*, produces a permanent loss of irritability, by coagulating the myosin. (*Richardson.*)

(*g.*) *Large losses of blood or the ligature of large arteries*, greatly impair muscular irritability. Of this we have been frequent witnesses. It has been a subject of dispute whether the blood has any appreciable influence upon post-morten muscular contractility. Thus it is said that muscular contractions under the influence of the interrupted current in an amputated limb, are just as marked after it has been drained of blood, as before. ("*American Journal of Medical Sciences*," Oct., 1846, p. 440.) This statement does not agree with our own experience; but be this as it may, it is practically certain that muscular irritability during life is more or less influenced, and may be even suspended, by great losses of blood.

Again, if a dead body be exposed to the action of ammonia, sulphuretted hydrogen, or carbonic anhydride, both the intensity and the duration of muscular contractility are lessened. On the other hand, there are certain vapors and gases, such as carburetted hydrogen, chlorine, and sulphurous acid, that seem to be without action in this respect.

(3.) The question remains: *How far can an opinion be formed as to the period of the death of a body from its condition of muscular flaccidity and contractility?*

In considering this question, it is important to remark that the involuntary muscles generally are more easily excited in the first instance than the voluntary, although, as a matter of time, their contractility is of shorter duration.

Again, we must note the order in which muscular contractility disappears:—

Onimus ("*Le Mouvement Médical*," Feb., 1873), states, that the first muscles to lose their excitability are the diaphragm and the tongue. The facial muscles, the masseter being the last of these, come next in order, their contractility usually lasting from two to three hours. In the limbs the extensor muscles yield first—the flexors retaining their excitability about an hour longer. Five or six hours after death the trunk-muscles still answer to faradization, and the abdominal muscles sometimes for even a longer period.

According to *Nysten*, who first suggested the loss of muscular irritability as a sign of death, the order in which it ceases is the following:—first, the left ventricle of the heart; then the intestines, stomach, urinary bladder, right ventricle of heart, œsophagus, and iris;

afterward the muscles of the trunk, and of the lower and upper extremities; and lastly, the left and right auricles of the heart.

The time when muscular irritability ceases in the muscles of the trunk and limbs after death from various diseases, was observed with great care at La Charité. The results obtained were as follows:—

In death from peritonitis, it ceased after three hours.

In death from phthisis, and carcinoma, after from three to six hours.

In death from cardiac diseases and hemorrhages, after nine hours.

In deaths from paralysis, after twelve hours.

In deaths from pneumonia, low fever, etc, after from ten to fifteen hours.

Summing up all the facts observed, and admitting great variations, depending on season, the temperature of the day, the age of the person, the cause of death, and lastly, the circumstances connected with the death, it may be laid down, as a general rule, that if the muscles are flexible and contract under the influence of the interrupted current (the experiment being conducted by preference on the trunk muscles or the flexor muscles of the limbs), death probably occurred within three hours, but most certainly within twenty-four hours of the time of the experiment, there being no recorded case where after-death flaccidity and contractility continued beyond this period.

Second Stage (B).

The period of cadaveric rigidity (rigor mortis).

This is the second stage after death. It is the death struggle of muscular fibre. ("*Med. Times and Gazette*," 1880, II., p. 709.) It was suggested as a sign of death by Louis in 1752, and it occurs after death, always, in all animals, vertebrate and invertebrate.

By "rigor mortis" we mean rigidity of the muscles, accompanied by stiffness of the limbs and joints. With rigidity there occurs a slight diminution in the volume of the muscles. Rigor mortis commences so soon as elasticity and muscular irritability cease, pliancy giving place to stiffness, and flaccidity to firmness. Thus in reptiles muscular irritability is very persistent, and as a result rigidity is late in appearing; whilst on the contrary, in birds, muscular irritability passes off rapidly and rigidity supervenes quickly. It lasts as a rule until putrefaction commences.

During the stage of rigor mortis, the muscles retain the precise position they occupied at the time that rigidity supervened. Thus a flexed limb remains flexed, and an extended limb extended. This fact has an important medico-legal bearing.

Rigor mortis is a phenomenon common alike to the involuntary and the voluntary muscles. Nysten, at the beginning of the present century, proved it to be dependent on the condition of the muscles, since he found it persistent after the ligaments, fasciæ and aponeuroses had been divided. On the other hand it could be prevented, or removed if it had already set in, by the division of the muscles or by separating them from their attachments.

Rigor mortis is altogether independent of the nervous system. (*Béclard* and *Hermann.*) The division of the nerve supplying the muscle, or indeed the removal of the entire brain and spinal cord during or before its occurrence, in no way affects it.

It is moreover altogether independent of the air, for it occurs equally well whether the body be placed in an atmosphere of pure oxygen or in a vacuum. (*Hermann.*)

Further, it is independent of temperature, although it is probably true that the early supervention of rigor mortis may have some influence in quickly lowering the surface temperature of the body. As a fact, rigidity frequently supervenes when the body is warm [as after malignant cholera (*Ollivier*)] and the blood fluid. (*Case* 18.) No doubt rigidity in most cases commences as the body is getting cold, but it commonly occurs first of all in those muscles that retain their heat longest. The congelation of a muscle neither destroys its irritability nor its power of becoming rigid, although undoubtedly cold both retards the appearance, and delays the disappearance of rigor mortis.

It has been said that the advent of rigor mortis betokens the actual death of the muscle. (*Küssmaul.*) It is true that rigidity commences when irritability ceases, but Brown-Séquard has shown that if a current of defibrinated arterial blood, or of aërated venous blood, be established through a rigid muscle, rigidity passes away and muscular irritability returns. ("*Gaz. Méd. de Paris,*" Nos. 24 and 27; "*Amer. Journ. Med. Sci.,*" Jan., 1852, p. 221. See also *Savory* on "*Life and Death,*" Lecture IV.) There is however no authority for the statement that has been made, that the setting in of rigor mortis is synchronous with the coagulation of the blood within the body, much less that the coagulation of the blood is the cause of the rigor mortis.

The true cause of post-mortem rigidity has been a subject of much discussion. Kühne was the first to suggest that it was probably a chemical act, and due to the coagulation of the myosin or muscle fibrin, the albuminous principle of muscular tissue. This body coagulates at a temperature of 104° F. (40° C)., and also when acted on by weak acids, such as by 10 per cent. solutions of hydrochloric acid. During life, Kühne considers that acid bodies are being constantly

formed in, and as constantly removed from, the system, but that after death these acid products accumulate in the muscles, and affect the coagulation of the myosin. This coagulation is, in his opinion, the cause of the rigor mortis. As putrefaction proceeds, however, the azotized matters of the body undergo decomposition and develop ammonia. This dissolves the coagulated myosin. Hence the disappearance of rigor mortis, and the subsequent flaccidity. ("*Lancet*," Jan. 22, 1881, p. 145 ; *Lecture by M. Richet at the Faculty of Medicine.*) It is also worthy of note, that if the coagulated myosin be allowed to remain for some time in the hydrochloric acid solution, the clot dissolves and a body called syntonin is found.

The study of the reactions of muscle under different conditions, lends support to this view. Thus:—

(1.) A living muscle *at rest* changes the color of both red and blue litmus. The action on the red litmus is, however, far more distinct than that on the blue. Hence the reaction of living muscle at rest must be regarded as faintly *alkaline.*

(2.) Immediately *after contraction*, muscle still acts both on red and blue litmus, but the action on the blue litmus is more marked than that on the red. Contracting muscle must therefore be regarded as possessing a faintly *acid* reaction.

(3.) During rigor mortis the muscles exhibit a well-marked *acid* reaction.

(4.) When rigor mortis passes off, the muscles become soft and inelastic. They then exhibit a well-marked *alkaline* reaction.

(5.) Lastly, it has been noted by Kühne that if a rigid muscle be exposed to a temperature of 120° F. (48.9° C.), its rigidity is greatly increased.

The forensic aspects of rigor mortis may be best discussed by considering the following questions:—

I. How soon after death does rigor mortis set in?
II. In what order are the various regions and parts of the body affected?
III. How soon does rigor mortis pass off?
IV. What are the circumstances modifying the time at which rigor mortis first appears, and the period during which it lasts?
V. By what means may post-mortem rigidity be distinguished from other forms of rigidity that occur during life?

I. *How soon after death does rigor mortis set in?*

Rigor mortis in the voluntary muscles, as evidenced by stiffness of

various parts of the body, usually commences at the third or fourth hour after death, and is complete about the fifth or sixth hour:—in other words it takes one to two hours to mature. ("*Brit. Med. Journ.*," March 7, 1874, p. 304.) Niderkorn, whose observations on rigor mortis appear to have been made with scrupulous exactness, states that in 79 of the 113 cases observed and recorded by him, post-mortem rigidity was complete between the third and sixth hour, but that in two cases only was it complete in two hours. He states, however, that in the whole of his 113 cases, one or more of the articulations were rigid within the first two hours of death.

Niderkorn's actual results are as follows:—

In	2	cases	rigidity	was complete	at the	2d	hour.
"	14	"	"	"	"	3d	"
"	31	"	"	"	"	4th	"
"	14	"	"	"	"	5th	"
"	20	"	"	"	"	6th	"
"	11	"	"	"	"	7th	"
"	7	"	"	"	"	8th	"
"	4	"	"	"	"	9th	"
"	7	"	"	"	"	10th	"
"	1	"	"	"	"	11th	"
"	2	"	"	"	"	13th	"
	113						

In the involuntary muscles rigor mortis occurs sooner than in the voluntary. Thus as a rule the heart becomes rigid and firmly contracted (a condition not unlikely to be mistaken for cardiac hypertrophy) in about one hour, extreme flaccidity (also liable to be regarded as a morbid condition) succeeding so soon as the rigor mortis passes off.

But the period when rigor mortis supervenes, may be either greatly extended or greatly shortened:—

(*a.*) Thus *rigor mortis may be late in appearing.* This happens more especially in cases of sudden death occurring in muscular and well-developed subjects. If death be sudden, the muscles not having been previously fatigued by violent effort, or the body weakened by pain and disease, we then possess the most perfect conditions possible for prolonging the stage of muscular irritability, and to a like extent for delaying the setting in of rigor mortis. Under such circumstances rigidity may not occur for twelve hours, or even longer, after death. Again, if the body be exposed to cold, rigor mortis is often slow in

making its appearance. There is, however, no well authenticated case where its advent has been delayed beyond twenty-four hours.

(β.) But, on the contrary, *rigor mortis may make its appearance very soon.* This is especially true in the case of certain parts and regions of the body. Rigidity of the eyelids frequently occurs within five minutes of death, "sometimes," as Guy remarks, "before the heart has ceased to beat."

Again, rigidity often sets in very rapidly in the facial muscles. And here it may be remarked that if the contractions of these muscles just before death have been powerful, the expression common to the person during life may suffer so complete a change, that identification within a few minutes of death may be rendered impossible. So also the placid face, resulting from the relaxed muscles of the first after-death stage, may acquire an expression of pain during the rigidity of the second. There is good ground therefore for the anxiety commonly displayed by old nurses to close the eyelids and bind up the lower jaw as soon as possible, lest rigidity should supervene before they had arranged and "composed" the corpse.

There are numerous recorded cases where complete rigidity has set in whilst the body has been warm (*Cases* 15, 18), a circumstance I have myself frequently observed in animals (*Ollivier*, "*Ann. d'Hyg.*," I., 233). Brown-Séquard records a case of death from typhoid fever, where rigidity commenced whilst the heart was actually beating, and within three minutes after respiration had ceased. ("*Proc. R. S.*," May, 1861.) Immediate rigidity is also recorded in the case of dogs poisoned by salicylate of soda (*Bochefontaine*), and after the administration of medium doses of strychnia (*Richet*). Sommer states that he has known rigidity appear in ten minutes after death, but never later than seven hours.

But facts show that not only may the flaccid condition of the first stage disappear within a minute or two of death, but that rigidity, or what for all practical purposes is indistinguishable from it, may supervene at the very moment of death:—in other words, that living contraction may pass at once into post-mortem rigidity, the stage of muscular flaccidity being practically non-existent. Thus numerous cases are on record where, *after* death, the body has retained the precise attitude that it assumed immediately before or *at* death, *i.e.*, as the final act of volition. It has been frequently recorded that the attitudes in which many of the dead are found on the field after a battle, are precisely those in which they met their death. Thus one man may be seen stiffened in the act of taking aim—the very expression of countenance, the kneeling position, the hands grasping the rifle, being accurately retained.

A second may be observed with his arm raised, holding his sword in clenched hand, as though prepared to strike. Ogston records how at Balaklava an officer, killed by a shell, retained his seat on horseback in a stiffened condition for some time before the body fell. (*Case* 3.)

And these cases are confined to no one special mode of death. Although it would seem that they happen most often after death from wounds of the chest, Dr. Brinton has shown that there are many similar cases recorded after death from gunshot wounds both of the head and abdomen ("*Amer. Journ. of Med. Sciences,*" Jan., 1870, Vol. LIX.).

Again, in cases of apoplexy (*Cases* 1 and 2) and after death from drowning, more especially when the water has been ice-cold (as in skating accidents), the last attitude of life has not unfrequently been preserved. (*Case* 7.)

It is right to note that many authorities (*Ogston, Taylor*, etc.) speak of this as something distinct from true cadaveric rigidity, under such names as "*cadaveric spasm,*" "*instantaneous rigor,*" "*tetanic rigidity,*" etc. Seeing, however, that no physiological distinction has been suggested between these states, and that there is no interval between this condition and what they call "true rigor mortis," no practical object is served in, and no scientific reason can be adduced for, regarding it otherwise than as cadaveric rigidity of instantaneous occurrence.

It has been commonly observed that where immediate rigidity has occurred, the period just preceding the death has been one of great fatigue and physical exhaustion. A hunted animal frequently stiffens the moment it is killed. In the appearances presented by the dead on the battle-field, it has been stated on good authority that the life-like stiffness we have described is observed very frequently in those killed at *the end*, and but rarely in those killed at *the beginning*, of the fight.

It is important here to guard against a possible mistake. The cases we are describing are, we repeat, those where there has been great fatigue before death; for as a rule, in cases of sudden death, the period supervening between death and rigor mortis—in other words, the stage of flaccidity and muscular irritability is longer than usual, more especially, as we have already said, when the subject is robust and muscular. Thus, after decapitation, Brown-Séquard records muscular irritability continuing (and rigidity therefore delayed) for ten or twelve hours. So again in asphyxia, Nysten records an interval of sixteen hours before post-mortem rigidity commenced. The cases, therefore, of instantaneous rigidity must be regarded as exceptional, occurring, not as the result, but in spite, of the sudden death, and

depending for the most part on the muscular exhaustion preceding the last hours of life. In cases of poisoning (as, for example, by strychnia) the continuance of muscular irritability is not so much determined by the action of the poison *per se*, as by the degree of exhaustion—the convulsions, spasms, etc., preceding death. And this explains why, after a small dose of a poison, where the time between the exhibition of the poison and death is considerable, the stage of muscular irritability and relaxation may be of short duration, whilst with a large dose, rapidly succeeded by death, the period of muscular irritability may be normal. Again, in death from hydrophobia, where the patient has been exhausted by suffering, post-mortem rigidity may occur, for all practical purposes, instantaneously.

When the last attitude of life is maintained after death, considerable light may be thrown on the question whether the case is one of suicide or of homicide. On this ground the precise position in which a body is found, demands the careful consideration of the medical jurist. (*Cases* 4, 6, 9 to 14.) He must in such cases note therefore:—

(*a.*) *The position of the dead body.*—Thus, after the suicide of two persons from hydrocyanic acid, I found the bodies firmly folded in each other's arms, as though, after taking the fatal draught, they had embraced one another, died, and stiffened in the act. It has been recorded, in the case of a man poisoned by the carbonic acid generated from a limekiln, that he was found some time after death in the attitude of sleep, resting his head on his hand, the arm being supported only on the elbow. (*Case* 5.) Again, the suicide may be found sitting in a chair, with dropped arms, but firmly grasping in his hand the pistol, knife, or other instrument employed by him to take away his life. (*Case* 10.) So strong, indeed, under such circumstances, may be the grip with which the weapon is held, that considerable force may be required to remove it from the hands. Or again, hand and arm may be fixed in the exact position of the last voluntary act, as *e.g.*, the attitude assumed in firing a pistol. (*Case* 4.) Or again, the after-death attitude may betoken the occurrence of a scuffle during life. (*Case* 6.) Thus from the position and posture of a body, we may gather important evidence to help determine in a case of doubt the question of suicide or homicide.

But there are other questions besides this upon which light may be thrown, by carefully noting the position and the attitude of a corpse. For example, it is often important to determine whether the place where a body is discovered, be the precise spot or not at which the deceased met his death. Or again, supposing it to be the place, the

question may arise whether there is reason to believe that the body has been disturbed or otherwise tampered with since death. In deciding these questions we must bear in mind (admitting that in rigor mortis the flexor muscles are always a little more contracted than the extensors), that the position of the muscles at death, unless disturbed during the period of flaccidity (in other words, the position when rigor mortis supervenes) is their position during rigor mortis. Without discussing numerous matters of detail, the three following propositions are, we believe, scarcely open to question:—

1. If a dead and rigid body, with open eyes and dropped jaw, be discovered *fitting itself* (as it were) *to the surface on which it rests*, the muscles of the buttocks or of other parts being flattened at the points of pressure, the probability is that the death occurred *at the precise spot* where the corpse is found. Supposing, however, there had been any interference with the body after death, such interference, it is next to certain, must have taken place *before* post-mortem rigidity set in.

2. If a dead and rigid body be discovered *not fitting itself to the surface on which it rests*—that is, if the limbs be twisted and contorted whilst the surface is even, or conversely if the body be straight and the surface uneven—the probability is that the place where the body is discovered, is not the place where the deceased person died. At any rate, it is next to certain, that the corpse has been interfered with, or otherwise disturbed, *after* post-mortem rigidity set in.

3. If a dead and rigid body be discovered evenly extended, and fitting accurately the surface on which it rests, having the eyes and jaw closed, it is practically certain there must have been some interference with the corpse after death, and before post-mortem rigidity commenced.

(*b*.) But *the position of the weapon, or the nature of the materials grasped by the hands*, may constitute evidence of even greater importance than the mere attitude of the corpse.

If a weapon likely to have caused the death be found tightly grasped in the hands of a dead body, it is important to observe its precise position. For example, if the weapon be a pistol, note must be taken whether the direction of the muzzle be such that the man may have shot himself, or whether the murderer, desirous of making the act appear suicidal, has in the flurry of the moment placed the pistol in the hands of his victim in such an impossible position as to furnish the strongest possible evidence in favor of homicide. Similarly, if a knife be found in the hand of a corpse, the sharp edge being [illegible]d backward, a conclusion of a like kind is suggested.

Again, any articles found in the hands of a dead body should be carefully preserved. Pieces of a dress, for instance, corresponding to that worn by a suspected person—or hair corresponding to that of the accused, clutched during a scuffle between him and his victim—have many times constituted evidence of the greatest value. (*Cases* 8, 9, 46.) In drowning, one of the most important proofs we possess of the immersion having taken place during life, is furnished by certain materials (weeds, for example) being found in the hands of the deceased, these having been clutched by him in his final efforts to save himself. The very materials themselves have not unfrequently furnished convincing proof, not only of the exact place where the person was drowned—for example, by comparing the weeds found in the hands with those growing on the bank or at a special part of the bank—but, if the act be homicidal, of the person or persons concerned in the murder.

Again, the force with which the various articles are grasped, should be carefully and immediately noted. *Immediately*, because when once the articles have been removed from the hands, no conclusions of any value can be formed by after experiments or observations (the conditions being so materially disturbed by handling) as to the power with which they were grasped.

The following points are worth attention:—

(α.) *If a weapon be found loosely held in the hands of the deceased, no conclusion of value can be deduced as to the question of suicide or homicide.* For it may have been suicide, partial muscular relaxation following the cessation of life;—or it may have been homicide, the murderer placing the weapon after death in the hands of his victim so that it may suggest self-murder. (*Cases* 11–13.)

(β.) *But if a weapon be found firmly grasped by the deceased person, suicide rather than homicide is indicated.* (*Case* 10.) It would be difficult for a murderer to place a weapon in the hands of his victim after death, unless the muscles were warm and pliant at the time; and this being the case, it is scarcely possible to conceive that the instrument would be found tightly grasped, unless it was held or secured in position during the period of muscular relaxation, and until post-mortem rigidity supervened. (*Küssmaul.*) But it is doubtful how far even this would be successful. It is probable, therefore, if a weapon be found after death securely gripped, that the deceased person committed suicide, and that no appreciable interval supervened between the death and post-mortem rigidity.

We need scarcely add that the presence or absence of blood on the instrument (*Case* 12)—the form of instrument considered in connection

with the character of the wounds—the hand (right or left) in which the instrument is found—its position in the hand, viewed in relation to the direction of the wounds (*Cases* 11 and 12)—the presence or absence of blood-marks, of powder-stains, or of injuries on the hands, and more especially on the hand grasping the weapon (*Cases* 12 and 13), are all important points to be observed in connection with the subject we are discussing.

II. *In what order after death are the various regions and parts of the body affected by rigidity?*

Nysten ("*Recherches de physiologie et de chimie pathologiques pour faire suite à celles de Bichat sur la vie et la mort,*" A.D. 1811) says, "This stiffness always begins in the human subject with the trunk and neck, then attacks the upper limbs, and from them proceeds to the lower, so that the latter may be still supple, whilst the former are already stiff. The stiffness follows the same order in disappearing, so that the legs are often stiff when the other parts of the body have regained their suppleness." [He does not mention the jaw at all.]

Sommer ("*De signis mortem hominis absolutem ante putredinis accessum indicantibus:*" Copenhagen, 1833—a rare book, quoted by Orfila) says, "Rigidity begins in the neck and lower jaw, then attacks the upper extremities, and lastly the pelvic limbs. It is rare for it to begin in the lower extremities, or to invade all four limbs at once." [In 200 cases, Sommer only found one in which it did not begin in the neck.]

Larcher (Memoir addressed to the Academy of Sciences, in the "*Archives de Médicine,*" 1862) founded on the examination of 600 bodies, states that, "The order of post-mortem rigidity is always the same, no matter what the kind of death, or whether it be sudden or slow, natural or accidental. The muscles of the lower jaw stiffen first, then the abdominal limbs, then the neck muscles; lastly, more or less slowly, the thoracic limbs (arms). The muscles, which are the first to stiffen, remain stiff the longest. It is also certain that the lower jaw, and the knee stiffen more slowly and thoroughly than the shoulder."

Casper states that, "It (*i.e.*, rigor mortis) passes from above downward, begins on the back of the neck and lower jaw, passes then to the facial muscles, the front of the neck, the chest, and the upper extremities, and last of all to the lower extremities. Usually it passes off in the same order, and once gone it never returns, the body becoming as flexible as it formerly was."

Niderkorn (loc. cit., p. 91) thinks there is no such invariable law as these authors suppose. He says the hip and knee, and the shoulder

and elbow, lose their rigidity together, and that in about one-half the cases, the foot and wrist go with their larger joints.

Our own observations on post-mortem rigidity, lead us to agree in the main with Ogston. The eyelids are first attacked, and then the muscles raising the lower jaw (masseter, temporal and pterygoid). These are followed by the muscles of the face generally, and then by those of the lower extremities; but most often, both the upper and lower extremities stiffen simultaneously.

The departure of rigor mortis follows the same order as its occurrence.

III. *How soon does rigor mortis pass off?*

Taylor gives sixteen to twenty-four hours as the usual period during which post-mortem rigidity lasts. This in our judgment is too short a time. Experience would lead us (reckoning from the very commencement of rigidity to the very end), to fix from twenty-four to thirty-six hours in summer, and from thirty-six to forty-eight hours in winter as the time of its continuance. It is difficult, however, we admit, seeing how variable its persistence is in different cases, to make any general statement as to the precise period of post-mortem rigidity. Thus:—

(α.) Rigidity *sometimes passes off very rapidly*—so rapidly, indeed, that it has been reported never to have occurred. There are unquestionable cases (especially where death has resulted from debilitating diseases) where rigidity has not lasted more than one or two hours.

(β.) Again, rigidity *sometimes lasts a very long time.* Thus in cold weather, and after death from certain diseases, its persistence is so great that it may continue for three weeks, or even longer.

IV. *We must now consider the circumstances that modify the time of its first appearance, and the period during which it lasts.*

(a.) *Age.*—Rigidity is less marked in the bodies of middle-aged persons (except the subjects be very muscular), than in those of the old, where the most complete post-mortem stiffness occurs. In the case of infants, rigor mortis usually sets in very rapidly, often before the body is cold. The existence of rigidity in a newly born child, may be regarded as proof that it has lived in a *physiological,* but not necessarily in the *legal,* sense, *i.e.,* that the child exhibited signs of life after it was completely external to the mother. (*Cases* 15, 16, and 17.) In *Case* 16, we have an illustration of strong rigidity occurring in the body of a child delivered by craniotomy. Many illustrations of still-borns exhibiting well-marked rigidity have occurred within our own

experience. Sommer records two cases of infants born asphyxiated. In order to resuscitate them they were put into, and left in, a warm bath, notwithstanding which, rigor mortis set in after three and four hours respectively.

(*b.*) *Temperature and atmospheric conditions.*—A low temperature and a dry air favor a long persistent rigidity. In the bodies of the drowned (more especially in winter when the water is ice-cold), it has been commonly noticed that rigor mortis lasts an unusually long time. Not only is the water on any given day always a few degrees colder than the air, but it is a better conductor of heat, thus retarding putrefaction. On the other hand, Brown-Séquard and Niderkorn (*loc. cit.*, pp. 32 and 59) have shown that rigor mortis may come on even in a warm bath (*see case just quoted*)—that it is exceedingly well marked in hot countries—and that it often supervenes even when the internal temperature of a corpse is above the normal.

(*c.*) *Condition of the muscular system.*—Both the first appearance of post-mortem rigidity and the period during which it lasts, are far more dependent on the muscular development and nutrition of the subject, than on any other cause. Thus rigidity often lasts a long time after violent death (as hanging), because in such case the system is less likely to have been previously weakened by fatigue or disease. Dr. Symonds found a body after judicial hanging rigid on the eighth day, whilst Brown-Séquard in cases of decapitation gives ten or twelve hours after death as the usual time of its appearance, and a week as the usual period during which it lasts. Küssmaul states that rigor mortis, after sudden death in a muscular subject often continues for fourteen days and even longer. Thus in all cases of rigor mortis the two points requiring special consideration are (1) muscular development, and (2) the extent of exhaustion and fatigue preceding death.

(*d.*) *Mode of death.*—Whenever death results from a lingering disease accompanied by great vital prostration (such as phthisis, hydrophobia, scurvy, low fever, etc.), or from violence preceded by intense physical fatigue (as in the case of those slain at *the end* of a battle), rigor mortis sets in speedily and disappears quickly. Thus it may last one or two hours only, and even be so slight as to be overlooked. This circumstance no doubt accounts for those cases where it has been reported never to have occurred at all.

Paralyzed limbs equally with others become rigid after death. In a hemiplegic patient, the rigidity of the paralyzed side is generally as well marked as that of the unaffected side. After death from lightning John Hunter stated that rigor mortis did not occur, but this Sir B. Brodie, Gulliver, Richardson, and others have shown to be an error.

(*Case* 19.) No doubt, in such cases, it may (and frequently does) set in very soon, and pass off equally rapidly. Where, for example, the lightning destroys life by an intense convulsion, every trace of muscular irritability may be destroyed, just as the advent of rigor mortis may be always hastened by exhausting muscular irritability before or even after death by the continuous application of galvanism. On the other hand, if death from lightning results from fright or from hemorrhage, the rigidity is usually of a more lasting nature.

It has been said that after death from small-pox, acute rheumatism, tetanus, meningitis, abdominal diseases, pyæmia, and the like, bodies become rigid rapidly, and remain so a long time. There are facts to support the statement that when death occurs during the time that the temperature is above the normal, the early appearance and long continuance of rigor mortis may be expected.

Again, in poisoning cases, rigidity as a rule sets in late and lasts long. It has been said not to occur after narcotic poisoning (*Casper*), but this does not accord with our experience. Habitual drunkards commonly exhibit a long continuance of post-mortem rigidity. But in poisoning we must again repeat that the primary question, as regards rigidity, is not so much the action of the poison, as the intensity of the exhaustion that has preceded death. This fact was strikingly illustrated by Brown-Séquard's experiments with strychnia on dogs. When the dose given was small and the death slow, accompanied by great exhaustion of the vital powers, rigor mortis appeared rapidly but lasted a short time only:—On the other hand, when the dose administered was large and the death correspondingly rapid, rigor mortis set in slowly and lasted a long time. An intermediate dose was found to produce intermediate results. This is shown in the following table:—

No.	Dose of strychnia given.	Death.	Muscular irritability lasted.	Rigor mortis lasted.	Putrefaction.
1	2.0 grains.	Immediate.	8.0 hours.	19 or 20 days.	Slow.
2	0.5 grain.	In 12 minutes.	2.5 hours.	5 days.	Rapid.
3	0.25 grain.	In 21 minutes.	0.5 hour.	Less than 1 day.	Very rapid.

The same thing is equally true no doubt of other poisons.

One general conclusion (we repeat) may be permitted. It is neither the disease nor the poison that determines either the time when rigidity sets in or the period during which it lasts, so much as the muscular power and energy of the person, and the extent to which these have been taxed before death by the action of the poison or the effects of the disease.

V. *By what means may post-mortem rigidity be distinguished from other forms of rigidity, such as may occur during life?*

When a joint, stiff from post-mortem rigidity, is forcibly bent, the stiffness passes away, and does not return, *provided rigidity be completely established.* If rigidity, however, has not completely set in when the limb is bent, a certain but less marked stiffness may return. Further, if a limb affected by rigor mortis be forcibly bent, it does not return of its own accord to its original position. But in the rigidity of hysteria, of the cataleptic state, and of syncope, or in the rigidity resulting from the action of certain poisons, the stiffness is *not* destroyed by forcible bending, whilst so soon as the force is removed the limb at once returns to its original position.

Further, post-mortem rigidity is accompanied by a progressive loss of heat. In disease, at any rate, the internal warmth is practically constant. This, with other signs of death, will prevent any possible confusion between rigor mortis and the rigidity occurring in some cases during life.

THIRD STAGE (C).

The period of putrefactive decomposition.

This constitutes the third and last period after death.

By putrefaction is implied "*a spontaneous change common to all nitrogenized organic bodies when exposed to the air, whereby they become resolved into new and simpler products.*" The putrefactive action is accompanied by the evolution of unpleasant gases, compounds for the most part of sulphur and phosphorus.

The putrefaction of a body usually commences when rigidity ceases. Dr. Taylor states this as an absolute rule. Exceptional cases, however, where rigidity and putrefaction coexist, certainly occur. (*Case* 31*f.*) Thus Dr. Woodman informed me that in the case of a young girl, he had seen well-marked rigidity a week after death, although putrefaction had set in, and had even attacked the face. The weather at the time was somewhat cold.[1]

Putrefaction may be regarded as an infallible sign of death, provided it be general and advanced. ("By this time he stinketh," S. John xi. 39.) Partial putrefaction, however, or the mere existence of certain of the effects usually indicative of putrefaction, can scarcely be

[1] Carpenter mentions (p. 1029, in a foot-note) that in the case of negroes in the last stage of the adynamic fevers of the African Coast "death and decomposition appear to extend gradually upward from the extremities to the trunk, so that the former may be in a state of absolute putrescence before the respiration or circulation have been brought to a stand."

regarded as of much value in this respect. Thus (1) after some local injuries, more especially if they occur in persons of feeble health, a portion of the body may die (gangrene). (2.) Again, a *smell* undistinguishable from post-mortem putrefaction, occurs in certain diseases, such as in gangrene of the lungs, ulcers, caries of bones (ozœna), etc. And, once more (3), *appearances resembling the color changes of putrefaction* may be closely simulated by bruises, etc.

We shall consider first of all

I. The Appearances due to Cadaveric Ecchymoses (*ἐκχύω, to pour out*).—[Hypostases (ὑπο ἱστημι) of Casper—Subcutaneous hypostases—Cadaveric Lividities—Post-mortem stains—Sugillations—Vibices.]

We consider post-mortem stains here for convenience only. Chronologically the subject belongs to the first stage of muscular flaccidity. Cadaveric lividities are not the result of, nor are they in any respect related to, putrefaction, although their effects have frequently been mistaken for it.

By cadaveric ecchymoses or lividities, we imply certain after-death stains, closely resembling in their general appearance the effects of bruises or contusions. They occur, both externally and internally, on the lowest and most dependent parts of the body.

We shall consider these stains under the two divisions of A. *External Ecchymoses*, and B. *Internal Ecchymoses*.

(A.) *External Cadaveric Ecchymoses.*

External ecchymoses generally show themselves during the eight or ten hours succeeding death, that is, whilst the body is warm and the blood liquid. When the blood has coagulated and the body cooled, the progress and formation of cadaveric ecchymoses cease.

These ecchymoses, which are *invariably* found in one part or another after death, vary greatly in their extent according to the amount of blood present in the body. In other words, the size of cadaveric ecchymoses depends on the fulness of the vascular system. Thus, if cadaveric ecchymoses be well marked and of considerable extent, covering the entire under surface and dependent portions of the body, vigor of circulation at the time of death is indicated, and *vice versâ*. The increase of redness in one part may thus explain an increased post-mortem pallor in another. These stains occur, according to Casper, even after death from hemorrhage and anæmia, a statement disputed both by Devergie and Ogston. Age, sex, and constitution have no apparent effect on their formation.

In considering the cause of these post-mortem ecchymoses, we must first of all note the changes the blood undergoes in the body after death. The blood *within* a dead body coagulates in much the same manner as it does when withdrawn from the living body. The top or highest portion is the least colored, whilst the lower portions are deeply colored. Thus it may be noted that the arrangement of a blood-clot within the body, may indicate the posture of a corpse for some hours after death. ("*Sir James Paget on the Coagulation of the Blood after Death.*" *London Medical Gazette*, XXVII., p. 613.)

But forensically, the *time* is of greater importance than the *manner* of coagulation. Blood when drawn from the body during life, or within the first three or four hours after death, coagulates almost directly it is exposed to the air, but when it remains in the body, that is, in contact with animal structures, some six to ten more hours may elapse before coagulation occurs.

But the precise time required for coagulation, whether in or out of the body, depends upon the quantity of fibrin present in the blood. This varies greatly in different diseases:—consequently the formation of post-mortem ecchymoses, depending as they do in great measure on the time that the fluidity of the blood lasts, will vary considerably according to the cause of death. Thus in acute inflammations, where the amount of fibrin in the blood is large, coagulation may precede the actual moment of death, and in fact be the cause of death. Hence cadaveric ecchymoses in such cases will be of limited extent. Conversely, in other diseases, such as phthisis, where the quantity of fibrin in the blood is small, the blood coagulates slowly. Cadaveric ecchymoses in such cases will be extensive.

Having noted these general facts respecting the coagulation of the blood in dead bodies, we may now follow the formation of cadaveric ecchymoses.

The *fluid* blood, which during life was equally distributed over the body, gravitates after death to the lowest and most dependent parts—*i.e.*, by death, the blood becomes obedient to the laws of inert matter. The blood stagnates in the dependent parts, congestion of the superficial, and now non-contractile, capillaries resulting—in other words, cadaveric ecchymoses form. There is but little doubt, however, that something more than the mere liquidity and coagulation of the blood has to be considered in determining the true nature of post-mortem stains. Some lake-like solution of the blood-coloring matter, resulting from the ammonia developed during decomposition, probably takes place, whilst the varying degrees of the oxidation of the more or less

superficial blood may serve to explain some of the curious color changes occasionally to be noted in these ecchymoses.

The post-mortem stains thus produced are dark, often slate-colored, or of a coppery-red or reddish-blue tint, and more or less mottled. They are never elevated above the skin. They are usually irregular both in size and outline, but well defined and even abrupt in their boundaries.

There are two other peculiarities of these ecchymoses worth noting:—

(*a*.) Although they appear on the most dependent parts, they do not occur on those portions of the body that are subjected to actual pressure:—in other words, they are not found where the body and the bed are in actual contact. The passage of the fluid blood into the superficial capillaries being prevented, these spots of actual pressure appear as a rule more than usually pale.

External pressure may thus determine both the shape and the appearance of post-mortem ecchymoses. Thus, it is important to observe that by the mere pressure of the clothes, or of the surface on which the body rests, stripes (*vibices*) may be produced, closely simulating the effects of flogging. Congestion in such a case takes place within the interstices of the folds, whilst the parts compressed remain white. Again a line round the neck having the appearance of the mark of a cord, or other marks suggestive of violence, may be produced in a similar manner. In all post-mortem hypostases, however, the cuticle will be found unbroken. (*Cases* 21 and 22.) Occasionally post-mortem ecchymoses (particularly after death by lightning) assume an arborescent or tree-like form, due to the distention of the cutaneous capillaries and small veins.

(*β*.) If whilst the body rests on its back, ecchymoses form on the depending parts, they may be made to disappear more or less completely, *provided the blood remains liquid*, by turning the body over on the belly. Fresh ecchymoses on the now depending portions of the abdomen, will replace those previously existing on the back.

From the facts stated it will be seen how important it is for the medical jurist to distinguish accurately between post-mortem ecchymoses and bruises the result of violence inflicted during life. The points of resemblance between these are often so great that mistakes are not only possible, but have no doubt frequently been made. (*Case* 23.) Further, after putrefaction has set in, and when the tissues have become soft and the blood easily diffused, the difficulty in distinguishing the one from the other becomes greater. The following tabular statement may render the distinctions between the two clear:—

Table showing the points of difference between a vital ecchymosis (bruise) and a post-mortem ecchymosis (lividity).

Bruise produced during life.	*Post-mortem ecchymosis.*
1. *Anatomical seat.* Effusion of blood from small ruptured vessels into the true skin and the surrounding cellular or areolar tissue (subcutaneous tissue).	1. *Anatomical seat.* Congested capillaries in the rete mucosum and vascular tissue *above* the true skin.
2. *Position.* The seat of the injury.	2. *Position.* Such dependent parts of the body (according to how it may be placed) as are not subjected to pressure.
3. *Appearance.* The bruise will often be noted to have the shape of the instrument that inflicted the injury. Its color not generally uniform. The bruised part is often elevated above the surrounding skin.	3. *Appearance.* Irregular in shape, but with well-defined edges. The color uniformly dark. Not elevated above the skin.
4. *Extent.* More or less limited to the parts injured.	4. *Extent.* At first the stain appears in isolated patches, rapidly running together more or less over the whole of the dependent portions, except those parts subjected to the pressure of the surface on which the body rests.
5. *Results of incision.* Effused blood at once flows from the cut.	5. *Results of incision.* No effused or coagulated blood escapes, although perhaps a few bloody points where the veins have been divided (*puncta cruenta*) may be apparent.
6. *Changes by time.* The dark purple bruise after eighteen to twenty hours, or sometimes as late as two or three days, becomes highly tinted at the edges, and of a more or less violet color. After this the color of the bruise passes through various shades of green, yellow, and lemon, the centre, however, always being the darkest part. During these changes, which are dependent on the oxidation of the effused blood, the spot enlarges. The changes are complete in times varying from a few days to some weeks.	6. *Changes by time.* The color remains tolerably constant until putrefaction sets in. No zones of color form round the edge, such as occur in a life bruise.

It is evident, therefore, that as a rule the distinctions between a bruise produced during life and a post-mortem ecchymosis are fairly well defined. In *Case* 23, however, zones of color were apparent in an after-death lividity, whilst the anatomical seat of the post-mortem ecchymosis, as described, was said to be the subcutaneous tissue. This case shows the need of great caution in such inquiries. No doubt the blood in this instance was diluted and diffused, as Taylor suggests, by the general dropsy from which the man suffered. It may be noted that the cadaveric ecchymoses occupied as usual the dependent parts of the body.

Dr. Ogston remarks that these stains are not such absolute indications of the reality of death as might at first be supposed, because there are marks occasionally met with in the living (which however do not necessarily occur on the dependent parts), difficult to distinguish from post-mortem ecchymoses. These lividities may be found at times on the legs and feet of aged persons and of those dying from adynamic diseases (such as scurvy, typhus, etc.), or on other parts of the body after death from apoplexy, hanging, or suffocation, or from carbonic acid poisoning. Similarly dusky red patches (frost erythems) occur on the body as the result of low temperatures, and may prove an important indication of death having resulted from the effects of extreme cold.

(B.) *Internal or Visceral Cadaveric Ecchymoses.*

The cause of internal lividities is the same as of external, and like them they *occur in the dependent parts of the several viscera.* This fact is important to remember in determining whether the redness be due to disease, or to a post-mortem lividity.

Internal cadaveric ecchymoses are found chiefly in the following situations:—

(*a.*) *The veins of the pia mater and the posterior hemisphere of the brain.*—This follows as a result of the ordinary position in which the body is placed after death. Care must be taken not to confound cerebral post-mortem lividities with the results of congestive apoplexy.

(*b.*) *The posterior part of the spinal cord, and particularly of its pia mater.*—These hypostases must not be confounded with pre-existing meningitis, or be mistaken for the results of violence to the back inflicted during life.

(*c.*) *The posterior part of the lungs.*—Cadaveric ecchymoses are all but invariably found in the lungs. About one-fourth of the entire

viscus is as a rule affected. They are, moreover, found at a very early period after death. Care must be taken that this condition is not ascribed to pneumonia or to apoplexy of the lung.

(*d.*) *The dependent parts of the stomach and intestines.*—This condition might be mistaken for the effects of inflammation. To determine to which cause the redness is due, the convolutions of the intestines should be stretched to their full extent. In post-mortem ecchymoses, breaks in the redness are certain to be observed, whilst in inflammation no such want of color continuity will be apparent.

The heart is not subject to cadaveric ecchymoses, but after death coagulated fibrin, stained with blood-coloring matter, is found in the cavities (cardiac polypi). This coagulation no doubt takes place after death, although there are reasons to think that it may occur in some cases just at the moment of death.

Bile stains.—Very soon after death (often after only a few hours) the bile undergoes certain changes (of the precise nature of which we are not well informed) whereby its coloring matter oozes through the gall-bladder. Thus the contiguous parts of the stomach and intestines may become stained of a yellow or greenish-yellow color, presenting an appearance not unlikely to be mistaken by an incautious observer for the action of a corrosive poison.

II. Putrefaction Proper.

This we shall discuss in the following order:—

I.—The general phenomena of, and the changes produced on the body by, putrefaction. In other words, the *external* results of decomposition, recognizable without dissection.

These are:—

(α.) Color changes.

(β.) The development of the gases of decomposition.

II.—The circumstances that modify the order, and the rapidity, of putrefaction. These may be considered under three heads as follows:—

(α.) General modifying conditions.

(β.) Burial in earth.

(γ.) Submersion in water.

III.—The question arises "How far the medical jurist, from the external inspection of a body, can form an opinion as to the length of time that the person has been dead?"

IV.—The changes in the tissues and viscera resulting from putrefaction. In other words, the *internal* or visceral effects of putrefaction revealed by a post-mortem.

V.—The production of—the circumstances modifying—and the appearances due to, the formation of adipocere (saponification).

VI.—The appearances due to mummification.

I. The general phenomena of, and the changes produced on the body by, putrefactive decomposition:—in other words, the external results of decomposition recognizable without dissection.

(*α.*) *Color changes.*—The first color sign of putrefaction is a slightly purple, or greenish, or yellowish-green patch, occurring commonly in the centre of the belly. This usually shows itself about the third day after death. The tint gradually deepens, until about the fifth day, the whole of the abdominal parieties will be found to have changed color, and the green tint to have more or less extended to the genitals. Green patches now begin to form on the neck, the back, the sides of the chest, and the inferior extremities, the body generally, through the green or purplish-green discoloration, presenting a peculiar marbled appearance. This is owing to the turgescence of the superficial veins, and to the changes effected on the blood-coloring matter by the gases of putrefactive decomposition. Toward the eighth or tenth day these patches of color coalesce, so that the whole face and neck exhibit a reddish-green tint, whilst the abdomen becomes of a brown or reddish-brown hue. At the end of a fortnight the whole body will be strongly colored, some parts being of a deep green or violet, and others of a brownish red or black. Beyond this the color changes can scarcely be traced.

No doubt the colors produced by putrefaction are chiefly due to chemical changes resulting from the action of the gases of decomposition on the hæmoglobin.

(*β.*) *Development of the gases of decomposition.*—The gases developed in the body during life, as for example in the stomach, differ in their composition from those formed after death. The gases formed *during life* are often inflammable, and usually contain considerable quantities of pure hydrogen. Thus in one case, the gas was found to contain 20.5 per cent. of hydrogen and 10.7 of carburetted hydrogen, with carbonic anhydride, oxygen, nitrogen, and a small proportion of sulphuretted hydrogen ["*London Med. Rec.*," 1874, p. 495 (*Dr. Schultze*), and Aug. 26, 1874 (*Dr. Ewald*)]. It is certain that the

gas developed in the body during life, contains as a rule very little sulphuretted hydrogen. *After death*, the composition of the gases formed, varies at different periods and under different circumstances, such as the nature of the contents of the stomach and intestines at the time of death (*Case* 31 *h*). In the earlier post-mortem stages, say until about the fifth or sixth day, the gases of putrefaction consist chiefly (according to my own experiments) of sulphuretted hydrogen, carburetted hydrogen, and ammonia, with variable proportions of carbonic oxide, phosphuretted hydrogen, nitrogen, and carbonic anhydride. But after the fifth or sixth day the proportions of sulphuretted hydrogen and of ammonia decrease, carburetted hydrogen and carbonic oxide then largely predominating. The gas present in some of the coffins removed from the vaults of the London churches was found to contain ammonia, nitrogen, and carbonic anhydride, but no sulphuretted, carburetted, or phosphuretted hydrogen.

If a puncture be made in the skin and a light applied, the gases of putrefaction will, as a rule, be found to burn with a yellow or blue flame (*Case* 31 *h*, *i*). Sometimes a series of slight explosions will take place on holding the light to the aperture from which the gas escapes. The gases formed continue to be very offensive up to about the twelfth or fourteenth day after death, when the quantity of sulphuretted hydrogen becomes comparatively insignificant.

Again, the rapidity with which gas is developed in the body after death, depends on a variety of circumstances. Thus if a body be taken out of the water and exposed to warm air, the quantity of gas generated within a very short period is often enormous, altering the features and general appearance of the corpse within a few minutes of its recovery.

We have now to consider the effects produced on the body by the development of the gases of decomposition. Ogston describes these under three heads, viz.: —

(i.) Distention and its results.
(ii.) Blood displacements.
(iii.) Fluid effusions.

(i.) *Distention and its results;* in other words, the body swells and becomes bloated, the belly, scrotum, chest, face, and limbs (in fact all parts) increasing in size.

Thus the specific gravity of the body, which normally is only a little heavier than water, becomes specifically lighter.

This explains why a body rises to the surface after some days' submersion, and sinks after the accumulated gas has escaped, rising a second time when fresh gas has formed, and so on.

Great as the power of the gases generated by putrefaction may be, it is seldom that a body bursts, because of the elasticity of the tissues. It is, of course, possible for a large evolution of gas to force open a leaden coffin, but if it be well made, and of thick lead, we should imagine such a circumstance must be of exceedingly rare occurrence.

The effects of distention are specially noticeable in the face. Thus the eyes, which after death collapse, as the result of fluid transudation, become more or less prominent so soon as the gases developed within the cranium and orbits are sufficient in quantity to force them forward (*Case* 33). This prominence of the eyes commences, as a rule, from the fourth to the eighth day after death (*Dr. Geoghegan*). One case is recorded where both eyes protruded sixteen hours after death.—(Dr. Taylor, "*Med. Gaz.*," June, 1850, Vol. X., N.S., p. 171.)

Not unfrequently the tongue swells from the development of gases within its pores. Thus it may either fall or be pushed forward by the *vis a tergo*, so that after death it will be found hanging out of the mouth. Strange to say that in Cases 33 and 34 the medical men regarded this appearance of the tongue and the prominent condition of the eyes as indicative of death by strangulation. In all such cases, careful note must be taken whether the tongue be bitten, or even indented with the teeth. In violent strangulation, further, the hands are usually clenched.

And again, the countenance and general features (particularly the lips, *Cases* 33, 34) may become so bloated and distended, that recognition may be rendered well-nigh impossible (*Cases* 31 *g*, 33, 34). This bloated appearance arises partly from the formation of gases in the loose tissues of the face, and partly by the blood being forced upward by the development of gases in the thorax and abdomen. The mucus and bloody froth commonly seen after death hanging about, or issuing from, the mouth and nostrils, is frequently due to this latter cause.

After the gases of putrefaction have been set free, the body increases in size; and further, in the case of children (and this is a matter of great importance to be remembered where the precise age of an infant or still-born is in question) makes them look considerably older than they really are. I have on more than one occasion seen a still-born, owing to the free development of gas, have all the appearance of a child a year old.

It is important to note that the development of gases in the body has been known to produce certain effects closely simulating vital acts. Probably gaseous distention is the usual cause of the occasional move-

ments of a corpse, such as its turning on the side after it has been "settled" in the coffin. Again it is recorded that the pressure of the gases generated in the abdomen has been sufficient to force fæces from the bowels, urine from the bladder, and even a fœtus from the uterus. (*Case* 73.)—("*Guy's Hospital Reports*," 1864, 3d series, Vol. X., p. 253.)

Dr. Aveling records a series of six cases collected from medical literature, where delivery is said to have occurred spontaneously after death. In one of the cases it is stated that the child was born alive. ("*Lancet*," April 27, 1872, p. 596.) It is certain that, as a rule, this spontaneous post-mortem delivery results from the pressure exerted by the gases developed in the abdominal cavity, although another explanation of this unusual occurrence has been suggested (page 47). Again the gases developed in the abdomen and intestinal canal, have (it is recorded) forced food from the stomach into the œsophagus and pharynx, and even out of the mouth. And, what is perhaps of even greater importance, the food thus forced upward has been known to find its way into the larynx, a result which, if discovered at a post-mortem, might give rise to a suspicion that suffocation had been the cause of death.

(ii.) *Blood displacements, occurring as the result of pressure on the heart and large vessels.*

This constitutes another series of effects produced by the generation of the gases of putrefaction. After death, the heart and large blood-vessels are usually empty. If any fluid blood remain in them, this is certain to be forced either into the superficial capillaries, or into the mucous and serous membranes, or into the vessels of the viscera. (*Cases* 33, 34.)

From this cause a diffused and intense redness of the skin and areolar tissue, very different to, and much later in appearing than post-mortem lividities, may often be observed after the cuticle has peeled off and putrefaction considerably advanced.

At times the effects produced by blood displacements have caused considerable alarm, owing to the pallid face of a corpse suddenly becoming red and rosy. I have seen this happen to an alarming extent, but in the case to which I am alluding, the original pallor rapidly returned when free exit was given to the gases confined in the thoracic and abdominal cavities. (*Case* 20.)

A marked redness of mucous and serous surfaces from this cause, must not be confounded with inflammatory redness. Besides the presence of false membranes, of purulent exudations, and of thickened tissues (all of which *if present* point *to*, and *if absent* point *from* in-

flammation as the cause of the redness), it will be noted that *in post-mortem redness*, the red color is limited to the course of the vessels, whilst *in inflammatory redness*, it is more widely spread.

The development of gases and the blood displacements consequent on the resulting pressure, explain the occurrence of what is known as *post-mortem hemorrhage*. This may occur before putrefaction has commenced, from the liquid blood oozing from a wound and afterward coagulating; but it may, and most often does, occur after putrefaction is fully developed, from the cause we are now considering. Thus is explained "bleeding after death," the origin of many a fabulous story of people coming to life after they were supposed to be dead.

A third effect produced by gaseous distention is:—

(iii.) *Fluid effusions into cavities.* We have traced the blood as it is forced into the capillaries by the pressure on the large vessels. The pressure on the overloaded capillaries continues to increase as the gases of putrefaction are developed. This constant pressure forces the serum (brownish red in color, offensive in odor, uncoagulable and tinged with blood) into the serous cavities, more especially into the pleuræ and pericardium. The fluid thus effused after death may be recognized by its being homogeneous, whilst that effused during life as the result of inflammation is usually non-homogeneous, and frequently contains pus and false membranes. These after-death effusions are said not to be found in cavities lined with mucous membranes (Orfila and Devergie). With respect to the time of their formation, they rarely occur for some weeks, but never during the first week, after death.

II. The circumstances that modify the order and the rapidity of the putrefactive changes in the body.

(α.) We shall present these modifying conditions as far as possible in a tabular form under two columns:—

(i.) The circumstances promoting putrefaction, and (ii.) the circumstances retarding putrefaction.

(β.) We shall then consider certain modifications of the putrefactive process resulting from the burial of a body in earth, etc.

(γ.) Certain further modifications of the process resulting from the submersion of a body in water.

(*a.*) *The circumstances respectively promoting and retarding putrefaction in a corpse.*

(i.) *Circumstances promoting putrefaction.*

1. *Temperature.* Warmth assists putrefaction by lessening cohesion. The most favorable temperature for putrefaction is between 70° and 100° Fahr. (21.1° and 37.7° C.). Thus one day's exposure in summer (75° F. or 24° C.) may effect a greater alteration than a week's exposure in winter. A warm room promotes decomposition.

2. *Moisture* promotes the process of putrefaction by effecting actual contact between the air and the tissue. The body naturally contains enough moisture (two-thirds its weight) for this purpose, but putrefaction is hastened if an excess of moisture be present. Such excess may be the result of disease (as dropsy) or may arise from the previous submergence of the body in water. Thus the viscera, according to the amount of moisture they con-

(ii.) *Circumstances retarding putrefaction.*

1. *Temperature.* Below 32° F. (0° C.) and above 212° F. (100° C.) putrefaction is entirely arrested. Cold prevents decomposition by intensifying cohesion, and heat by effecting the evaporation of moisture. A remarkable instance of the preservative power of cold is given by Adolph Erman, who states that the body of Prince Menschikoff, a favorite of Peter the Great, exhumed after ninety-two years' burial in frozen soil, at Beresov (in Siberia), had undergone hardly any change. (*See* also *Quarterly Journal of Science*, vol. viii. p. 95.) The rapidity of putrefaction grows less and less as the temperature rises above 100° F. (37.8° C.), until (as we have said) at 212° F. it is entirely arrested. Bodies buried in hot sand do not putrefy, but become mummified. Thus warmth (*per se*) has a tendency to retard putrefaction. It is only so far as it is associated with air and moisture that it promotes it. (*Case* 32.)

2. *Moisture.* If there be sufficient water to allow the entire submergence of the body, putrefaction will be retarded, because access of air is thereby prevented. Any circumstance rendering a body unusually dry, *e.g.*, its preservation in a dry and warm atmosphere, retards putrefaction.

tain, decompose at different times after death; the brain (more especially if air gain access to it) and the eye putrefying rapidly, whilst the bones, teeth, hair, and nails, decompose slowly. Speaking generally, any cause, or combination of causes, rendering the body preternaturally moist assists putrefaction.

3. *Air*. If blood or flesh be placed in a vacuum, its decomposition proceeds slowly. Similarly, decomposition is slow in atmospheres of hydrogen, of nitrogen, or of carbonic anhydride, or indeed of common air, provided a vapor (such as turpentine) be present, capable of absorbing oxygen. Air also promotes decomposition as a carrier to the body of the lower forms of organic life, which themselves have the power to start, or at any rate to promote, chemical changes.

A body putrefies more rapidly in air than in water, or after burial. Given similar temperatures, the degree of putrefaction developed in a body during one week's exposure to air, will about correspond to that developed after submersion for a fortnight, or after burial in a deep grave for a period of eight weeks.

A naked body putrefies more rapidly than a clothed one. Decomposition will be less rapid in parts where the clothes fit tightly (*e.g.*, in the feet with the boots on), or if the clothes worn be impermeable to air.

In a leaden coffin, putrefaction is slow from the oxygen soon becoming exhausted. Thus in the case of bodies buried in lead, the faces may be recognizable after the lapse of long periods of time.

3. *Air*. If access of air to a body be prevented by any means, such as by its enclosure in a close coffin, by tightly fitting clothes, or by complete immersion in water, putrefaction is retarded.

4. *Combined action of Warmth, Moisture, and Air.*

It is important to consider the action of these jointly as well as separately :—

Moist air promotes putrefaction.

Stagnant air promotes putrefaction.

A moist cold air in winter, assists putrefaction more efficiently than a *dry hot air* in summer.

A moist, hot, stagnant air is the most favorable atmospheric condition for putrefaction.

Thus of the three (air, warmth and moisture), the presence of moisture is a more important means of promoting putrefaction, than either warmth or air.

5. *Effects of burial.*

Putrefaction is promoted by—

(*a.*) The body having been kept for a long time exposed to the air before interment. Besides the mere action of oxygen, insects during exposure may find their way to the corpse and deposit their ova in or upon it. These, when hatched, materially assist putrefaction.

(*β.*) The grave being situated in low ground (as in a valley), and in a damp swampy soil.

(*γ.*) The body being buried without clothes or coffin. Thus where infants (as not infrequently happens) have been merely thrown into the ground, and loosely covered over with earth, putrefaction is rapid.

4. *Combined action of Warmth, Moisture, and Air.*

Dry air retards putrefaction.

Air in motion retards putrefaction.

A *dry hot air* in summer, retards putrefaction more efficiently than a *moist cold air* in winter.

A *dry cold air, in rapid motion*, is the least favorable atmospheric condition for putrefaction.

The removal of moisture from the body by whatever augments evaporation (as, *e.g.*, by warmth—free atmospheric currents, etc.) constitutes the most important means of retarding putrefaction.

5. *Effects of Burial.*

Putrefaction is retarded by—

(*a.*) Burial within a short time after death.

(*β.*) The grave being on high ground and in a dry, absorbent soil. Thus bodies buried in dry, warm sand often become mummified, in which condition they resist putrefaction almost indefinitely.

(*γ.*) The body being well wrapped in its shroud, and enclosed in a well-secured coffin, lead coffins being undoubtedly the most perfect in this respect. The oxygen present in such case is rapidly exhausted, whilst the remaining nitrogen is somewhat antiseptic in its action. Oak coffins are

	also very durable and efficient, but those made of deal or pine soon rot and fall to pieces. Burial in water delays putrefaction so far as it prevents access of air. Burial in peat delays putrefactive changes in a remarkable manner.
(δ.) Burial in a *shallow* grave, where the body is exposed to constant variations of temperature. The diurnal changes extend to about three feet below ground, and the monthly, or seasonal changes, to nearly six feet. Thus putrefaction is more rapid when a body is buried in six feet (or less) of earth than when interred in a deep grave.	(δ.) Burial in a deep grave. The deeper the grave, the more perfect the retardation, because the body is placed beyond the daily and seasonal changes of temperature. At a depth of six feet the temperature of the ground is low, and fairly uniform.
(ε.) Burial in marl or clay (if air have access), or in loose mould, or in porous soil impregnated with animal and vegetable matters. [It is possible under these conditions, if the ground be not too dry, that adipocere may be formed when putrefaction is suspended.]	(ε.) Burial in sand, gravel, or chalk. [In such cases adipocere is rarely formed, unless water finds its way into the grave.]
6. *Age and Sex.* Childhood.—According to Orfila, putrefaction is rapid in the *female* sex.	6. *Age and Sex.* Adults and old age.—Males are said to decompose less rapidly than females.
7. *Cause of Death.* Acute exhausting diseases (*Case* 31 *i*), such as hydrophobia, typhus, and typhoid (*Case* 31 *d*) (see "*Guy's Hospital Reports*," Oct., 1863), dropsy from organic disease, a diseased state of blood (pyæmia), delivery, etc., promote putrefaction.	7. *Cause of Death.* Thus putrefaction is delayed after death from chronic diseases (*Case* 31 *c*) unless they be associated with dropsy. In the case of plethoric persons who have died suddenly in good health, and after death by asphyxia, putrefaction is usually slow in appearing.
8. *Corpulence.* (*Case* 31 *h.*)	8. *Leanness.*
9. *Certain Poisons.* It is said that putrefaction is rapid after death by prussic acid, morphia, and narcotic poisons generally (*Casper*); also after death from certain animal and gaseous poisons, such as CO	9. *Certain Poisons.* Arsenic, antimony (*Case* 28), chloride of zinc, also chloroform, phosphorus, and strychnia, when they are actually the cause of death, usually retard decomposition.

and H_2S. The bodies of the intemperate usually putrefy rapidly. (*Case* 31 *h.*)

[N.B. In this case the true question, no doubt, is not so much the action of the poison as, *was the patient so exhausted by fatigue or pain before death, that rigidity supervened rapidly?*]

10. Any parts affected by bruises, fractures, or wounds, putrefy rapidly (*Case* 31 *a b e f g.*) Such portions of the body look worse a few hours after, than before death. Putrefaction is specially rapid in parts that have been subjected to surgical operation.

In arsenical poisoning, putrefaction ordinarily commences as usual, but seems to stop after it has commenced. Then a process very similar to mummification begins.

After death by sulphuric and other mineral acids, putrefaction appears to be retarded, possibly from the acid preventing the formation of ammonia, or combining with it as soon as formed.

11. *Lime.* Lime, if freely applied to a dead body, may retard putrefaction by preventing access of air. In smaller quantities, however, it acts both as a deodorizer and antiseptic. The attempts, not uncommonly made, to destroy a body by covering it with lime, usually on the contrary succeed in preserving it. (*Cases* 29, 30.) In tanning skins, the application of lime is adopted for the purpose of removing the fat and separating the hair. Possibly a little external softening of the cuticle may be thereby effected, but no change results so far as the tissues generally are concerned, the fact being that lime *prevents* putrefaction (and even arrests its progress, if already started) by changing the skin into a hard and dry substance.

12. *The mineral acids.* By such means putrefaction is retarded by the destruction of the tissues. (*Case* 30.)

13. *Various antiseptics.*

(β.) *Certain further modifications of the putrefactive process resulting from earth burial in coffins.*—For the most part, the changes that take place in a coffin, are similar, except that they are slower, to what would occur if the body were exposed to the air. We have already stated many of the conditions that modify the progress of putrefaction after interment (p. 77)—viz., the character of the coffin and of the soil—the depth of the grave—the time that has elapsed before burial—the cause of death, etc. Considering all the facts, it is scarcely within the power of the medical jurist to fix a definite period of death or time of burial, from the mere appearance of an exhumed body. Even under apparently identical circumstances the most variable results have been observed. Taylor records a case where, after 34 years' interment, an entire and perfect skeleton was discovered, surrounded by traces both of shroud and coffin, whilst in an adjoining grave, all that remained of a body that had been underground for 25 years, were the long bones and the base of the skull. In *Case* 37 the body was found well preserved after six years' burial, and in *Case* 43 we have a remarkable illustration of preservation after 30 years' interment.

We are indebted to Orfila, and some other observers, for certain general facts bearing on this subject worth recording:—

After periods, varying from a few months to one and a-half or two years, it will usually be found that the soft tissues of a body buried in a coffin become dry and brown, and the limbs and face covered with a soft white fungus. About this time, (although I have seen this condition on more than one occasion after less than two months' burial,) hard white crystalline deposits of phosphate of lime form on the surface of the soft organs. If these crystals occur on the mucous membrane of the stomach (a not unusual position), they might possibly be mistaken for the effects of poison. In the case (*Case* 38) of two children that had been poisoned with arsenic, and exhumed after seven months' burial, the faces were found well preserved, excepting the soft parts of the nose. The genitals were converted into adipocere.

After a period of four years, the viscera become so mixed together that it is difficult, if not impossible, to recognize or to distinguish them.

After eight years' burial (case of Peter Mawer, exhumed at Boston, 1862), Dr. Taylor found a body in fragments, the soft parts being loosely adherent to the bones, and covered with a white, fibrous, offensive-smelling substance. The features were entirely destroyed, and the bones of a dark color. [The body in this case had been buried in a damp grave, and the coffin had water in it, which contained animal matter, together with ammonic sulphate and phosphate.]

At later periods the soft parts, as a rule, entirely disappear. If a body has been buried in a very dry soil, portions may be found brown and mummified, in which condition they remain unchanged for a long time. In course of time the bones become disarticulated. At a still later period, the long bones only remain, the short flat bones, the base of the skull, and the vertebræ crumbling to a white powder.

Thus in Briand's case (*Case* 66) the body after eleven years' interment was found reduced to a skeleton. The third to the sixth cervical vertebræ, however, were surrounded by the remains of a cord, that had no doubt been criminally used to destroy life. The length and color of the hair, the state of the teeth, and the form and length of the bones, were recognizable. (This subject will be further discussed under Identity.)

The teeth, bones and hair are the most indestructible parts of the body. These may be found in perfect preservation after many years' burial, and possibly throw light on the age, sex and identity of the person. Unless, however, the body has been buried in lead, or the conditions have been favorable to the formation of adipocere, it is not likely that any of the soft parts will remain after the lapse of nine or ten years.

There is little question that children's bones decay more rapidly than those of adults, more especially if they be buried (as they often are) in superficial graves. Thus, in Case 67, a child's body (æt. 8) was completely decomposed after sixteen months' burial—the hair, lower jaw, and certain articles of dress constituting the only means by which identification of the remains could be established.

The action resulting from prolonged *burial in peat bogs* is remarkable. (*Case* 47.) Similar in many respects to burial in peat is Case 48, where a body was recovered after long interment in a turf bank at a depth of about ten feet. The remarkable preservative and antiseptic properties of the peat are strikingly illustrated in these cases, such action being no doubt due to the presence of tannic acid or of some body resembling it. But the most striking result recorded is the disappearance of the earthy matter of the bones. Thus in Case 47 no bone of any kind was found, and in Case 48 all the phosphate of lime had disappeared, so that the bones had entirely lost their solidity. It is clear, therefore, that peaty water must have some specially solvent action on bone. Whether, as has been suggested ("*Lancet*," July 5, 1873, p. 28), this is due to the free nitric acid said to be found in moss water, or to ulmic acid generated by the decomposition of vegetable fibre, or whether it be that whilst the peat preserves the skin and flesh the bones decay as usual by time, it is not easy to say.

(γ) There are certain special modifications of putrefactive decom-

position, that require study in the case of bodies submerged in water. The putrefaction of a body is far less rapid in water, if completely submerged, than it is in air, because of the lower temperature of the water and the exclusion of oxygen. A week's exposure to air is in this respect about equal to a fortnight's submersion. But the rapidity of decomposition in water varies. Putrefaction is fairly rapid when the water has a temperature of from 64° to 68° F. (17.8° to 20° C.). In stagnant water, again, putrefaction is more active than it is in running water, whilst in shallow water (the heating power of the sun's rays being expended on the superficial layers), putrefaction is more rapid than in deep water. A body may be found fairly well preserved, after eighteen months' burial in deep water. Further, putrefaction would be retarded if the body became coated with mud, a condition which after prolonged submersion frequently occurs. (*Cases* 36 and 39.) In cesspools, putrefaction is as a rule retarded, because the conditions are such as to favor the formation of adipocere.

If a body be recovered from the water, after eight or twelve days' submersion in summer, or after a still longer period in winter, the probability is that no very distinct signs of decomposition will be apparent. But if it be now exposed for a few hours only to the air, very rapid decomposition ensues. So rapid indeed is the putrefaction of a body after its recovery, that twenty-four hours' exposure may then effect infinitely more marked putrefactive changes, than would have resulted from a fortnight's longer submersion. The face rapidly becomes bloated and black, rendering identification well-nigh impossible. (*Cases* 35, 44.) (See also *Case* 36, where the face was well preserved after 29 days' submersion.)

It is important to note that a bruise or contusion produced during life, might not be apparent in the case of a dead body when first recovered after some days' submersion. After a very few hours' exposure to air, however, the bruise would probably manifest itself with even a somewhat exaggerated severity, owing to the specially rapid changes of color certain to result under such circumstances.

About the twelfth day of submersion in summer, a change of color commences. This is first observed on the ears and temples, then on the face, from which it spreads to the neck. It appears afterward on the shoulders, chest, and abdomen, and lastly on the legs. This order of putrefaction is, in the main, agreed to by Casper, Briand, and Kanzler, and, it will be observed, is almost the inverse order of parts affected by putrefaction in bodies exposed to air. Thus—

Order of parts affected by putrefaction in air: Abdomen, genitals, breast, face, neck, superior and inferior extremities.

Order of the parts affected by putrefaction in water: Face, neck, breast, abdomen, legs.

Casper even states that the order in which the various parts exhibit color-changes, affords strong evidence either in favor of, or against death by drowning; but I have reason to believe that this inverse order of putrefaction in water and in air occurs equally, whether the body be submerged alive or dead. I agree with Ogston, moreover, in his statement that occasionally (although rarely) the color-changes in submerged bodies commence on the abdomen.

The gases of putrefaction are equally developed in water as in air. Thus the body after a short time (as we have already mentioned) becomes buoyant, very little gas indeed being necessary to make it rise. A short time after it has risen to the surface the gas escapes, and the body sinks, rising a second time when a sufficiency of fresh gas has formed.

As regards the *position* in which the body floats, it will be noted that either the back or the abdomen (and in the case of females it is invariably the latter) seems lifted above the water, whilst the head and the extremities invariably remain below the surface.

The appearances presented by the body at different periods after submersion, have been stated by Devergie as follows ("*Annales d'Hygiène*," Vol. II., p. 160; Vol. V., p. 429; Vol. VI., p. 209):—

First four or five days.—Little change. Post-mortem rigidity may persist to the fourth day in some cases, particularly if the water be cold.

Fourth or fifth day.—The skin of the ball of the thumb and little finger, and the lateral surfaces of the fingers begin to whiten. On the sixth or eighth day this extends to the palms of the hands, and the soles of the feet. The skin of the face will appear softened, and of a more faded white than the rest of the body.

Fifteenth day.—The face is slightly swollen and red. A greenish spot begins to form on the skin of the mid-sternum. The hands and feet are quite white, except the dorsum or the latter, and the skin of the palms appears wrinkled. The subcutaneous cellular tissue of the thorax is reddish, and the upper part of the cortical substance of the brain of a green tint.

At one month.—The face is reddish brown, the eyelids and lips green and swollen, and the neck slightly green. A brown spot, with green areola, about six inches in diameter, occupies the upper and middle part of the sternum. The skin is very wrinkled, but the hair and nails are still adherent. The scrotum and penis are now much distended by gas, so that from this cause the latter is sometimes erect. The lungs become very emphysematous, and overlap the heart. (In *Case* 36, the absence of tumefaction after twenty-nine days is recorded.)

About the sixth or the seventh week.—The neck and thorax become very green, and the cuticle at the wrists begins to separate.

At two months.—The body is covered with slime, which penetrates through the clothes. The face will appear enormously swollen and brown, and the lips parted, so as to expose the teeth. The skin on the middle of the abdomen, as well as that on the arms, forearms, thighs, and legs, remains in a natural state, thus contrasting with the phenomena of putrefaction as it occurs in air, where the abdomen is the first part to exhibit change. The skin, with the nails attached, now begins to come off, like a glove, from the hands and feet; the hair falls off, or can easily be detached. The veins are almost completely empty of blood, and filled with gas. If at the moment of death the right cavities of the heart were gorged with blood, the internal surface of the right ventricle will now appear of a jet black color. Devergie insists strongly on this.

At two and a half months.—The green color of the skin extends to the arms, forearms, and legs. The nails are quite detached from the hands and feet. Some *adipocere* will be formed on the cheeks, chin, breasts, armpits, and internal parts of the thighs [see before, pp. 19–26]. The abdomen will be greatly distended by the gases of putrefaction. As yet the muscles are not much altered in color.

At three and a half months.—The scalp, eyelids, and nose are so destroyed as to render recognition, or determination of age, difficult or impossible from mere inspection. The skin of the breast is generally of a greenish brown, and the centre of the abdomen of an opaline appearance, studded with small ulcerations. Larger erosions are found on other parts of the body. The hands and feet are quite bare of skin. The lungs no longer fill the thorax, but leave a space between them and the pleura costalis filled with reddish serum.

At four and a half months.—The face and scalp are so destroyed as to leave the skull bare. The remains of the face, neck, and interior parts of the thighs are entirely converted into *adipocere*, and small eminences, indicating the commencement of calcareous incrustation, will be observed on the prominent parts. The brain presents traces of adipocere on its anterior portions.

After prolonged submersion the skin becomes blue, green, and black. As putrefaction advances the muscles become soft and discolored, certain parts suffering conversion into adipocere. In course of time the soft parts of the body are washed away from the bones, and the adipoceratous portions get broken off. Finally, the skeleton separates. (*Case* 39.)

In one case, where *a body was drowned in a cesspool* (*Case* 66*), its complete reduction to a skeleton, after eight or nine months, is recorded. This most unusual result is to be accounted for by the influ-

ence of the putrescent animal surroundings, which in this case had failed to effect the conversion of the body into adipocere, a result which, under such conditions, might have been expected.

Having considered the changes resulting from putrefaction, and the time occupied by these changes under varying conditions, we are now led to consider the following important question:—

III. How far can the medical jurist, from the external inspection of a body, form an opinion as to the length of time that a person has been dead?

This question may be asked:—

(1.) In a case where the body of a child has been discovered, in order if possible to connect its birth (as proof of identity) with the delivery of a woman suspected of being the mother.

(2.) If the body of an adult be found under circumstances suggestive of homicide, the opinion of the medical jurist may be sought as to the probable time of death, to connect the crime, if possible, with some person or another suspected of being concerned in the murder.

In the earlier post-mortem stages, a fairly accurate opinion may, *under certain circumstances*, be formed of the period that has elapsed since death. As a rule putrefaction commences by a green discoloration of the abdomen about *the third day* after death. At the same time it must be remembered that this discoloration may occur earlier than this (*Case* 33) as well as later (*Case* 32), just as rigidity may, on the one hand, set in rapidly (as, *e.g.*, in cases of extreme prostration), and on the other hand be very late in appearing, as Brown-Séquard has shown to be the case after decapitation.

In the later stages after death, we agree with Orfila that it is "utterly beyond the power of man" to give a decided, or indeed any opinion of value as to the time of death, even with a full knowledge of the circumstances of the case. *Case* 35 shows the difficulty and danger of attempting that which the present state of our knowledge does not justify. *Cases* 49 and 50 are excellent illustrations of how very different may be the results of decomposition under practically identical conditions. In *Case* 50 the results recorded are precisely opposite to what we should have expected. We repeat, it is evident that the commencement of putrefaction after death may vary within the widest possible limits. This subject has more than once proved of great medico-legal importance. Thus in *Case* 32, the question arose, Was the absence of putrefaction in the body consistent with the person having met his death six days previously? If it was *not*, there was an absence of any evidence of value to connect the prisoner

(Desha) with the murder; if it was, then the evidence against the prisoner was strong. Again, in *Case* 33 many important questions turned on the time of death, which could only be judged by the extent to which putrefaction had advanced. Much medico-legal controversy is reported to have occurred in this case, one side stating that the decomposed face, protruded eyes, swollen lips, projected tongue, the frothy liquid issuing from, and the larvæ about, the mouth, the generally discolored state of body, etc., indicated that the person had been dead for at least four or five days, whilst others held (and amongst them Dr. Geoghegan) that such changes were not inconsistent with far more recent death. Admitting the exceptional nature of such a case, our own experience proves that a few hours may suffice to produce all the effects recorded, and that the medical jurist is not justified in fixing a definite time of death merely from putrefactive changes. Similarly in *Case* 34 the rapidity of the after-death changes was undoubtedly exceptional, but the medical jurist has to consider in all such cases the possibility of exceptional occurrences. Hence whilst stating what might be expected under like conditions, dogmatism in such matters is in the highest degree dangerous, cases proving incontestably that putrefaction is not to be relied upon as a positive indication of the time that a body has been dead.

In advanced stages of decomposition, an opinion of value may undoubtedly be formed as to the nature of wounds and injuries involving want of continuity. With these putrefaction will not materially interfere. On the other hand, mere bruises or superficial marks of violence (such as the mark of a cord round the neck) will probably be obliterated as putrefaction progresses, or, if recognizable, will scarcely furnish definite evidence as to their nature or cause. (*Case* 33.) Mistakes in such cases are recorded, and preach care.

One further point is suggested in cases of exhumation: that is, not to mistake injuries (say fractures of bones) caused by the pick and spade of the grave-digger or navvy, for marks of violence inflicted during life. (*Case* 41.)

Regarding the order in which the external phenomena of putrefaction occur in bodies exposed to the air or buried, we cannot do better than quote, with such alterations as experience suggests, the rules laid down by Casper. They are to be regarded as *average results* only:—

Twenty-four to seventy-two hours after death.—A light green color, visible about the centre of the abdomen. The eyeballs soft, yielding to external pressure.

Three to five days after death.—The green color of the abdomen becomes intensified and general, spreading, if the body be exposed to the air or

buried in the ground, in the following order:—Genitals, breast, face, neck, superior and inferior extremities.

[If submerged in water the following order is usual, and as regards time appears later than in the case of air—Face, neck, shoulders, sternum, abdomen, legs.]

Eight to ten days after death.—The color becomes more intense, the face and neck presenting a shade of reddish green. The ramifications of the subcutaneous veins on the neck, breasts and limbs, become very apparent. The patches congregate. Gases begin to be developed in, and to distend the abdomen and hollow organs, and to form under the skin in the submucous and intermuscular tissues. The cornea falls in and becomes concave. The sphincter ani relaxes. The nails remain firm.

Fourteen to twenty-one days after death.—The color over the whole body becomes intensely green, with brownish red or brownish black patches. The body generally is bloated, and appears big from the development of gases in the abdomen, thorax and scrotum, and also in the cellular tissue of the body generally. The swollen condition of the eyelids, lips, nose and cheeks is usually of such extent as to obliterate the features and to destroy the identity of the body. The epidermis peels off in patches, whilst in certain parts (more particularly over the feet) it will be raised in blisters filled with a red or greenish fluid, the cuticle underneath frequently appearing blanched. The color of the iris is lost. The nails easily separate. The hair is loose.

The fourth to the sixth month after death.—The thorax and abdomen burst, and the sutures of the skull give way from the development of gases within. The viscera appear pulpy, or perhaps disappear (melt away), leaving the bones exposed (colliquative putrefaction). The bones of the extremities separate at the joints.

At an advanced stage the soft parts gradually disappear.

Another question arises here: *May putrefaction commence in a body before death?* Partial putrefaction undoubtedly may, but not general putrefaction. A peculiar condition of luminosity of breath, and also of the face and other parts of the body (*Cases* 24, 25, 26) has been urged in proof that general putrefaction may happen. But so far as luminosity is concerned (a property that may be studied better, because seen oftener, in fish), it is certain that not only does it not result from putrefaction, but that it ceases (if present) immediately that putrefaction commences.

Case 27 is difficult of explanation. Possibly, however, there is some error as to the precise source of the phosphorescence. Of course the putrefaction of a portion of the body may occur during life, gan-

grene being such a condition. But this is vastly different to a general putrefaction of the whole body.

IV. The Changes in the Tissues and Viscera resulting from putrefaction: in other words—Internal effects revealed by a post-mortem.

The alterations produced in the tissues and viscera by putrefaction, are practically two, viz., *softening* and *discoloration*.

The various internal organs are affected by putrefaction in very different degrees, depending on the difference of their structure, the different quantities of blood they contain, and the ease or otherwise with which air can gain access to them.

But both discoloration (congestion) and tissue-softening are also found as morbid conditions. It is important, therefore, to note how far it is possible to distinguish between congestion and softening occurring as the result of disease, and similar appearances arising from putrefaction. The following points are worthy of note:—

The discolorations of putrefaction are most marked (like external hypostases) in the lowest and most dependent parts of the organ, whilst the congestions of life are scarcely determined by position. Further, the putrefactive changes in one viscus may, by contact, promote putrefactive changes in an adjoining viscus. This communication of color-change from viscus to viscus at the precise spot where they touch, is at all times strongly suggestive of putrefaction.

Cadaveric softening generally affects an entire viscus, whilst the degree of softening in the several viscera, or in different portions of the same viscus, will greatly depend on the density of the viscus, or on the part of the viscus affected. Further, in putrefactive softening no adhesions of the organ to the walls of its cavity will occur, nor will pus be found infiltrated through the tissues. In inflammatory softening, on the contrary, it is rare for an entire viscus to be affected, the softening being, as a rule, partial and limited. Further, either adhesions or effusions of serum into cavities, or infiltrations of pus, are almost certain to be found in cases where the redness is the result of disease.

We may now consider the putrefactive changes in the various internal organs, stating them, as nearly as possible, in the order of time in which the viscera are severally attacked. Speaking generally, the windpipe and brain yield first, and the heart, lungs, and arteries last.

(A.) *Organs and parts that putrefy rapidly.*

1. *Larynx and Trachea.*—These are the first internal parts of the

body that show the effects of putrefaction, probably because they are the most ready of access to air. In from three to five days after death in summer, and in from six to eight days in winter, the larynx, and top part of the mucous membrane of the trachea assume a brownish-red or olive-green color. Care must be taken not to confound these discolorations (for the diagnosis is not always easy) with the results of laryngitis, or of death by drowning or suffocation.

2. *The Brain of Infants.*—The causes of early putrescence in the brains of infants and of young children, are twofold: (1) the easy access of air through the fontanelles; and (2) the soft and pulpy condition of the brain normally. [Hence the *adult* brain putrefies much less rapidly than the brains of young children.] Whilst other parts are fresh, and even the abdomen untainted, the infant brain may become of a rose-red color, and sufficiently liquid to flow out of the skull, so soon as the bones of the cranium are removed. (*Case* 38.)

If the cranium be entire, the putrefactive gases may, by their pressure, force the pulpy brain substance along the cerebral and internal jugular veins, whereby a condition may result closely simulating phlebitis. The rapid post-mortem changes that the brains of children undergo, often render post-mortem examinations, in the case of infants, unsatisfactory as a means of determining the precise cause of death.

Given discolorations of the membranes of the brain, or even of the brain tissue, pathologists are fairly agreed that it is practically impossible to state with any absolute certainty whether such discolorations are due to inflammation or are dependent on post-mortem changes.

It is said that in inflammatory softening, exudation corpuscles (not present in cadaveric softening) may be observed in the brain substance under the microscope.

3. *Stomach.*—In times varying from three to eight days [4 to 6, (Casper)], irregular and circumscribed patches of reddish-brown or purple, or black discolorations may be observed. These patches are of very varied size and shape, and are usually surrounded by dark-colored venous branches, that seem to wind around and about the discolored portions. These patches usually occur first of all on the posterior wall of the stomach, the pre-existing post-mortem lividities being the centre of the putrescent changes. In a very short time, however, the change becomes general, from the coalescence of the patches. With this change of color the stomach becomes soft to touch, and in some cases exceedingly friable.

It is important to consider with what normal or abnormal conditions these putrefactive color-changes in the stomach may be confounded:—

(α.) *Certain articles of food.*—The ingestion of a dark-colored port, or of highly colored fruits (such as black currants, etc.), or of *certain medicines* (such as iron, or a strong infusion of the Papaver Rhæas (*Christison*), etc.,) shortly before death, may stain the stomach of various tints likely to prove deceptive.

(β). *Certain Inflammatory Diseases* (such as catarrh of the stomach, etc.).

(γ.) *Redness incident to digestion.*—If, at the time of death, digestion be proceeding actively, more especially if the quantity of food in the stomach be small in quantity, considerable redness of the mucous membrane may be present.

But there is another condition worthy of note, which long ago attracted the attention of John Hunter, viz., what is called Post-mortem Digestion (or solution) of the stomach. John Hunter describes this state as follows:—

He says: "There are very few dead bodies in which the stomach at its great end is not in some degree digested; and one who is acquainted with dissections can easily trace these gradations. To be sensible of this effect nothing more is necessary than to compare the inner surface of the great end of the stomach with any other part of its inner surface. The sound portions will appear soft, spongy, and granulated, and without distinct blood-vessels, opaque and thick, while the other parts will appear smooth, thin, and more transparent, and the vessels will be seen ramifying in its substance. Upon squeezing the blood which these vessels contain from the larger branches to the smaller, it will be found to pass out at the digested end of the vessels, and to appear like drops on the inner surface" (*Hunter's Animal Economy*," Owen's edition, p. 119). If this post-mortem digestion has been active, the stomach may be found perforated, and the contents to have escaped. Dr. Fenwick ("*Morbid States of the Stomach and Duodenum*," pp. 42–47) has discussed this subject with some detail. This condition of post-mortem solution is most apparent in persons killed suddenly (*e.g.*, by lightning) whilst digestion is going on, also in cases of phthisis, in diseases accompanied by acid dyspepsia, and after death from cerebral disease. It occurs more frequently in warm than in cold weather.

(δ.) *The effects of alcohol.*—If brandy or other powerful stimulants be taken just before death, a slight reddening of the mucous membrane of the stomach is commonly observed at the post-mortem. It is curious, however, that, in some cases, after death from alcoholism (acute and chronic), the stomach when first opened is exceedingly pale, but becomes intensely red after a short exposure, so as to give the appearance of active inflammation.

(ε.) *The action of irritant poisons.*

(ζ.) *The effects of hanging and drowning.*

(η.) There are *certain other post-mortem conditions* of the stomach that might mislead as to their cause. Of these the changes produced in the blood-coloring matter by the gases developed as the result of putrefaction, and the transudation after death of the contents of the gall-bladder into or upon the stomach, are illustrations.

In putrefaction all the coats of the stomach (muscular and mucous) equally undergo softening and change of color. This being so, the peeling off or separation of the mucous coat from the muscular, as a result of putrefaction, is of rare occurrence. Casper says he has never observed it take place; but, although I admit it to be infrequent, I certainly have witnessed such a separation, even in the very early stages of putrefaction. In other forms of discoloration (as, for example, that arising from irritant poisons) it is the mucous membrane which is more particularly, if it be not the only part, affected.

And this practical conclusion arises from what has been stated, viz.: that post-mortem discolorations of the stomach, considering the many chances of error, are scarcely to be regarded, *per se*, as of much importance in proof of the administration of an irritant poison.

But in cases of poisoning there are other conditions of the stomach to be considered besides mere redness. Thus arsenic acts commonly (but by no means necessarily) as a preservative agent, so that, in a case of arsenical poisoning, a fairly accurate opinion may sometimes be formed as to the condition of the mucous membrane after the lapse of even three or four weeks. Again, there are cases where the post-mortem appearances of the stomach at very advanced periods after death (*e.g.*, in the case of the strictly corrosive poisons) are definite and distinct. Further, important conditions are sometimes superadded to discolorations and softening, such as finding a deposit on the mucous membrane of the stomach of reduced mercury, or of particles of white arsenic, or of an arsenical sulphide. Hence, whilst caution is necessary in forming an opinion of poisoning on mere color-change, it must be remembered that the post-mortem examination of the stomach, even at very distant periods after death (omitting altogether for the moment the results of chemical analysis) may furnish evidence of poisoning of the greatest possible value. And, lastly, it is to be remembered that putrefaction in many cases helps, rather than interferes with the toxicologist in his search for poisons.

4. *The Intestines.*—The putrefactive changes that take place in the intestines are similar to, but later in their appearence than those described as occurring in the stomach. The peculiarities of post-mor-

tem lividities in the intestines have been already described. (See p. 81.)

5. *The Spleen.*—Sometimes this organ putrefies very soon after death, and sometimes very late.

6. *Omentum and Mesentery.*

7. *Liver.*—The livers of children putrefy considerably sooner after death than those of adults. Commencing with a green discoloration on the convex surface, the color rapidly spreads over the whole viscus, until at last it becomes almost black. (*Case* 34.) The gall-bladder putrefies at a much later after-death period than the liver.

8. *Brain of Adults.*—Collapse, with change of color in the adult brain, usually commences in the grey matter at the base of the cerebrum, and spreads upward. The brain becomes soft in from two to three weeks after death, unless air finds access to it through a fracture of the skull, when the change is more rapid. Under ordinary conditions some months elapse before the adult brain becomes actually pulpy.

(B.) *Organs and parts that putrefy slowly.*

1. *The Heart.*—The heart may be found flat, empty of blood, but still fresh and surrounded by its dried pericardium, long after advanced putrefaction has affected the parts and viscera already described. (*Case* 38.)

2. *The Lungs.*—The time when putrefaction commences in the lungs is far more variable than in the case of the heart. It is true that putrefactive changes may occur in the lungs very soon after death (*Case* 38), but as a rule these organs resist putrefaction for a long time. This fact is important in considering the value of the hydrostatic test as a proof of respiration, putrefaction being one of the difficulties that occur to its use. When putrefaction commences in the lungs, isolated bullæ, varying in size from a millet seed upward, form in various parts under the pleuræ. These bullæ, in the first instance, do not effect any change in the general appearance of the lungs, but as their number increase, the lungs become soft, of a dark black color, and putrid.

The lungs may be inflamed (reddened) as the result of disease. This condition in such case will be observed at the post-mortem, no matter how soon after death the examination is made. Hepatized tissue will probably be found, moreover, around the inflamed portions, the general mass in some parts being soft, and in others indurated and of a livery consistence.

3. *The kidneys.*

4. *The bladder.*

5. *The gullet.*—This may be found firm and unaltered many months after death, even when the stomach and intestines have ceased to exist.

6. *Pancreas.*

7. *Diaphragm.*—Sometimes a change of color occurs very shortly after death, but as a rule the diaphragm may be distinguished after the person has been dead for at least six months.

8. *The larger blood-vessels.*

9. *The uterus.*—This organ resists putrefaction longer than any of the other soft parts or viscera of the body (Casper). (*Cases* 51, 52, 53.) Dr. Quinnell, of Jhung, confirms this statement by reporting a post-mortem on the body of a woman, where decomposition had advanced so far that the bloated skin had burst in places and the brain become fluid, nevertheless "the womb was as yet free from putrefactive changes and perfectly healthy." ("*Indian Medical Gazette*," Jan. 1, 1875, p. 4.) As a fact, pregnancy may always, and the recent expulsion of the contents of the uterus may very frequently, be made out in a body where decomposition is very far advanced, and where no opinion can be formed either as to the cause of the abortion or of the death.

Presence of vermin.—As putrefaction advances in bodies exposed to the air, vermin make their appearance. (*Case* 33.) They chiefly attack the exposed parts of the body, such as the face and fingers, and leave signs of their ravages, which, as a rule, have distinct and well-defined edges. On the contrary, where loss of tissue results from putrefaction, the edges of the parts are usually soft and ill-defined. As regards vermin, the possibility of their ravages producing effects simulating wounds must not be overlooked; at the same time, it must be remembered that the existence of sores and wounds on a body is likely to be an attraction to worms and maggots. ("*Indian Med. Gazette*," Jan. 1, 1875, p. 4.)

Lastly: one or two practical thoughts suggest themselves:—

1. We are never justified in refusing to perform a post-mortem, merely because of the putridity of a corpse, or of the length of time that has elapsed since death. Thus in the most decomposed body we may usually find sufficient data by which to determine *the sex*, if not by external, at least by internal observations (*Cases* 38, 51, 52); also *the age* more or less accurately, and very often *the mode of death* (as *e.g.*, in many cases of poisoning—after death from violence, aneurism, etc.). Again, we may be able to prove or disprove the existence of pregnancy from the presence or the absence of fœtal bones (*Case* 52). And once more, the evidence resulting from the discovery of false teeth, rings,

various body malformations (such as club-foot, etc.), or the remains of old injuries (such as fracture, etc.), may prove of the greatest possible value in identification.

Thus in Dr. Harvey's medico-legal returns (see "*Indian Medical Gazette*," Jan. 1, 1875, p. 3), he remarks that "it is rare for any body on which a judicial post-mortem has to be made in India to be quite free from decomposition, and very many in which the cause of death was clearly made out were greatly decomposed." The extent of putrefaction, often urged as an excuse for not making a post-mortem, is, says Dr. McLeod, invalid, "and the careless or superficial or hurried examination of human remains, in whatever state presented, is a palpable dereliction of duty." Personal inconvenience in this matter must give way to the requirements of law. Admitting that decomposition may often render it impossible to say whether certain appearances are the results of wounds or not, and may often prevent our speaking positively as to the cause of death, the fact still remains that certain evidence of our inability to do so can only be given after most careful dissection. As a rule, the obliteration of pathological signs does not correspond with the period of maximum offensiveness. (*See Case* 34*.)

2. If a body be recovered in such a bloated condition that recognition is rendered impossible, although in the highest degree important, the features may sometimes be restored to a remarkable extent by immersing the body in a saturated solution of alum and nitre in alcohol. I am able to speak from practical experience of the success of this method, and Dr. Richardson mentions another case, occurring to Dr. Henry, of Alta, where some such process proved valuable. ["*Vierteljahrss.*," Vols. XXV. and XXVI. (Prof. Hofmann, of Vienna), "*Lancet*," May 16, 1863, p. 551, and "*Med. Times and Gazette*," December 9, 1871 (Dr. Richardson).]

3. Dr. Richardson has suggested the following as a good disinfectant preparation where we are called upon to make a post-mortem on a putrid and offensive body:—

Iodine	1 drm.
Methylated ether (sp. gr. 0.720).............	10 ozs.
Absolute alcohol..........................	1 oz.
Sulphuric acid....	4 drms.

Dissolve the iodine in the mixed ether and alcohol, and slowly drop the sulphuric acid into the mixture.

Dr. Richardson explains that the iodine acts as a deodorizer, that the sulphuric acid fixes the alkaline products of decomposition, and

that the spirit gives general firmness to the structures. The liquid is to be poured over the putrid body, when it is rapidly absorbed and the body effectually deodorized. Where a suspicion of poisoning exists, and it is probable that an analysis of the viscera and the contents of the stomach will be required, it is unquestionably preferable to avoid all disinfectants, for fear of introducing difficulties into the chemical examination. Still, if any deodorizer must be employed, it is well to use some preparation the composition of which is exactly known. ("*Med. Times and Gazette*," December 9, 1871, p. 701.)

Although, as we have said, a post-mortem on a putrid body is not to be shirked because of its condition, nevertheless the medical jurist must beware of attempting to prove too much as the result of the examination. To recognize features, even after treatment, may be, and often is, impossible. To differentiate with scientific accuracy between disease and post-mortem changes—to decide how long the person has been dead—or in the case of two bodies to determine priority of death, are details concerning which the medical jurist, save in exceptional cases, is rarely qualified at advanced post-mortem periods to give definite opinions.

V. The Appearances due to the formation of Adipocere (Adeps, *lard*, and cera, *wax*), (Saponification):—

(1.) *The History of Adipocere.*—Although adipocere is said to have been known to the ancients, and is mentioned by Lord Bacon, this substance attracted little attention till the publication of Fourcroy's "Memoir," to the Royal Academy of Sciences of Paris (1789). He found that the bodies removed from the Cimetière des Innocents in Paris presented three different conditions:—(1.) The most ancient were simply portions of bones, irregularly dispersed by frequent disturbance. (2.) In certain bodies the skin, muscles, etc., were dry, hard, more or less grey, and mummified. But (3) the most singular state of all was observed in the "fosses communes," where large numbers of bodies had been interred in deep pits, one above the other. On opening many of these, nothing was discovered but irregular masses of a soft ductile matter, of a grey-white color, resembling common white cheese. "It was sometimes nearly white, at others yellowish brown; sometimes brittle and dry, but always more or less unctuous or soapy." Since the publication of this Memoir many researches have been made into the formation and constitution of this singular substance adipocere, a body by no means invariably of the same composition.

(2.) *Constitution and composition of Adipocere.*—Adipocere is a true ammoniacal soap, that is, a combination of fatty acids (oleic,

stearic, and perhaps palmitic acids), with ammonia. As commonly found, it has mixed with it certain coloring matters and altered organic tissues (pure adipocere being structureless), together with the various lime, potash, and other salts found in the animal solids and fluids.

There is, however, an adipocere that has lime and not ammonia for its base. Possibly this may depend on the nature of the medium in which the body is submerged, but whether the lime adipocere be formed from ammonia adipocere, or is itself a primary body, is a matter of doubt.

(3.) *Formation.*—Two things are required to form adipocere:

(α.) Fatty matter.

(β.) A nitrogenized body (such as fibrin), capable, by decomposition, of yielding ammonia.

The ammonia thus formed combines with the fat to form adipocere. Hence adipocere could not be formed from pure fat alone, or from pure fibrin alone. But inasmuch as all fat globules are surrounded by a nitrogenized investing membrane, and all parts contain more or less fat, practically the whole body is capable of conversion into a more or less pure adipocere.

(4.) *The circumstances modifying its formation.*

(α.) *Age.*—In children and young people where there is much superficial fat, adipocere is more rapidly formed than in the bodies of adults.

(β.) It forms more readily, and in greater abundance (as we should expect), in fat than in lean bodies.

(γ.) *Water.*—Complete immersion of the body in running water favors its formation.

(δ.) Its formation is especially promoted by burial in an *overcrowded churchyard* and in *cesspool soil* (themselves abounding in fatty and decomposing nitrogenized matter), and by interment in *deep graves*, from the probability of the body, under such circumstances, coming into contact with an excess of moisture.

Adipocere is rarely met with in bodies buried either in sand or gravel.

(5.) *The Properties of Adipocere.*—Adipocere is a white, or a yellowish-white, or a brown soapy body. [Lime adipocere is commonly whiter and harder than ammonia adipocere.] It has an offensive, rancid odor increased by warming. When perfectly dry, it is white, hard, and brittle.

It has no structure, but it always occurs in nature more or less mixed with fragments of tissue.

It floats on water. It melts at about 200° F. (93.3° C.), some samples fusing a little below, and others above this temperature. When heated strongly on platinum, it melts, the vapor evolved smelling strongly of ammonia, and burning with a bright yellow flame. A brown mineral residue (equal to about 5 per cent.) remains after incineration, and consists of sodic and potassic carbonates, sodic chloride, phosphate of lime, and oxide of iron. When distilled, it yields a dense oily acid vapor, a carbonaceous mass remaining in the retort. With water, it makes an opaque lathery mixture, having an acid reaction. It is soluble in alcohol, but is re-precipitated from the spirit solution on the addition of water. It is also soluble in a solution of potassic hydrate, a white precipitate being formed when the alkaline solution is neutralized with acids.

Acids generally decompose it. Sulphuric acid chars it. A red colored liquid results on boiling it with strong hydrochloric acid. Heated with a caustic alkali, ammonia is evolved.

Adipocere is a very permanent body. A case where it was identified after seventeen years' burial, is recorded. ("*Phil. Med. Exam.*," April, 1847, p. 267.)

(6.) *The time required for the production of Adipocere.*—It is possible for the whole body (as we have said) to be converted into adipocere, but the breasts, cheeks, and kidneys (that is the parts where fat abounds), are the first to undergo this change. The muscles suffer conversion at later periods.

Devergie gives one year when the body is covered by water, and three years when it is buried in moist earth, as the periods which, under ordinary conditions, must elapse before *complete* conversion into adipocere will be effected.

But the question arises:—What is the earliest period after death at which, under specially favorable conditions, adipocere may be formed?

Casper says that adipocere is not formed to any extent, according to his experience, under three to four months' submersion in water, and six months' burial in moist earth.

In a famous trial, where much depended on the time necessary for saponification (*Case* 44), the following evidence was tendered:—

Mr. Dickenson said that he thought that the conversion of a body into adipocere pointed to its having been under water for at least six weeks (a statement in which Dr. Bree agreed), but he also stated that he had seen a greasy spermaceti appearance in a body after submersion for a shorter period.

Dr. Gibbes stated that he had been able to procure a little adipo-

cere, after the maceration of a body in water for a month, but that as a rule it required a longer time.

Of recorded cases the following must be noted:—

Devergie records the case of a new-born child having been found completely adipoceratous after six weeks' burial in water-closet soil.

A case is recorded (*Case* 44) of the body of an adult being found partly adipoceratous after submersion in water for six weeks.

A case is recorded where a body buried in a dry place (?) was converted into adipocere after four months' interment. (*Case* 46.)

Several cases are recorded of adult bodies being found partly adipoceratous after three to four months' submersion in water.

A case is recorded where the genitals of a child were converted into adipocere after seven months' burial in a dry soil. (*Case* 38.)

Casper records a case where the body was one-third adipoceratous after thirteen months', and a second after six and three-quarter months' burial.

Taylor states that he has found the fat of the breasts, etc., adipoceratous after one year's interment in earth.

Taylor records the case of a female buried in a damp grave, in which the lower part of the body (*i.e.*, the level to which the water had reached) was adipoceratous after fourteen months' interment.

Many cases are recorded where the change has been almost complete after two or three years' burial or submersion. (*Case* 45.)

It is evident, therefore, that *partial* saponification may be expected (the conditions being favorable) after three months' submersion in water, and after twelve months' burial in earth. But it must be admitted that this and any other rule is to be regarded as elastic, recorded cases showing the formation of adipocere at very much earlier periods under specially favorable conditions.

Lastly, it is worth recording that Billroth removed the fruit of an extra-uterine pregnancy, *perfectly* converted (bones and tissues) into adipocere, every part being entire. The woman was believed to have been pregnant two years before the operation was performed. ("*British Med. Journ.*," Dec. 4, 1880, p. 897.)

VI.—The appearances due to mummification.—The desiccation and mummification of bodies may be natural. Our dissecting-rooms frequently supply illustrations in old and bloodless subjects, where the bodies settle down into brown dry masses. Similar changes occur in dry, and in senile gangrene. Bodies exposed to a dry air and protected from moisture (as for example when buried in hot dry sand, or confined in air-tight metal coffins), are frequently preserved for long periods, and undergo complete natural desiccation.

Ogston records one case of the body of an infant that appeared perfectly mummified after concealment for one or two years in a dry stone wall, and a second case of a similar kind in the body of a child that had been shut up in a box for three months. In Case 38, where two children had been buried in a dry soil for seven months, partial mummification occurred in both cases. This case is complicated, however, by arsenic having been found in the bodies.

As regards the time that bodies may remain in this natural state of mummification, it is difficult to speak positively. ("A tanner will last you nine year.") But it is certain that a medical jurist would scarcely be justified in expressing any opinion as to the probable time of death in the case of a corpse that had undergone this change.

Mummification of the cord.—At periods varying from a few minutes to two days after the funis has been tied, it begins to shrivel. This change is termed *mummification*, and is really the death of the cord. The shrivelling commences at the ligature, and spreads toward the attachment of the cord with the body. Complete desiccation (when the cord assumes a flat, brownish, parchmenty, and more or less translucent appearance) is usually complete about the third day.

Artificial embalming is a process of exceedingly ancient date. Its history has been well told by Dr. Richardson. (See "*Med. Times and Gazette*," 1871, II., pp. 701, 717 and 761, and 1875, I., pp. 1 and 360.) Very varied were the processes adopted, and as varied were the reasons adduced for the operation. Cases are recorded where for fear of premature burial people have requested by will, that they should be embalmed before burial. Of methods, we give one or two illustrations.

(A.) *Hunter's* directions for embalming a body (adopted in the case of the Earl of Moira) were as follows:—("*Med. Times and Gazette*," December 9, 1871, p. 717.)

(*α*.) Remove the whole of the abdominal and thoracic viscera and the brain in the manner ordinarily adopted at a post-mortem.

(*β*.) After wiping out the various cavities with a cloth, wash them thoroughly with cold lime water. This done, the entire body is to be immersed in rectified spirit.

(*γ*.) The intestines and bladder, after they have been emptied of their contents, are to be immersed first in lime water, and then in spirit. In the case of the other viscera, the blood is first of all to be well squeezed out, and Friar's balsam freely applied. After this all the parts are to be thoroughly covered with "spices." [A mixture of coarsely powdered cloves, nutmeg, cinnamon, pepper, frankincense, myrrh and alum.]

(δ.) A bed of spices having been prepared in the abdominal cavity, the viscera are to be returned, and the belly, crammed with spices, secured with waxed twine.

(ϵ.) The lungs are to be treated in a similiar manner with Friar's balsam and spices, and the thoracic arteries and veins, etc., plugged with spices. The lungs are then to be replaced in the thorax, which after being well crammed with spices, is to be secured in a similar manner to the abdomen.

(ζ.) The heart is to be emptied as far as possible of its blood, and saturated with Friar's balsam. It is then to be stuffed with spices, and finally preserved in an urn, which is also to be packed with spices and hermetically sealed.

(η.) The brain is also to be treated with Friar's balsam and spices, and returned to its cavity, well packed in spices, and secured as usual.

(θ.) The mouth, throat, and nostrils are to be packed with spices wetted with Friar's balsam.

(ι.) The whole body having been sewn up and well secured, is to be washed with lime water. When dry, each member separately is first of all to be rolled in a waxed cloth, and finally the whole body enveloped in one large waxed cloth.

(B.) *Richardson's* process, which he has described in great detail in the "*Medical Times and Gazette*" (Jan. 2 and April 3, 1875), is shortly as follows:—

(α.) A current of air charged with ammonia is first of all to be injected into the vessels. The brachial or the femoral artery is to be used by preference for this purpose.

(β.) A weak spirituous solution of zinc chloride[1] is now to be *slowly* and *gently* injected [2] (*i.e.*, avoiding the use of too much force, or of too much fluid), lest any rupture of vessels within the cavities should occur. It may be known when the injection has been carried far enough, by the body assuming a white mottled appearance. The corpse (with the instrument in place) is then to be allowed to remain undisturbed for six to twelve hours.

(γ.) In order to plug the artery, and to prevent the escape of the liquid, four to six ounces of a saturated solution of silicate of soda are to be injected into the vessel before the instrument is removed. This done, the artery is to be tied, and the opening in the skin stitched up with silk.

[1] Saturate two pints of water with zinc chloride, and add to this one pint of alcohol and one of water.

[2] The injecting apparatus recommended is figured in the "*Medical Times and Gazette*," April 3, 1875, p. 36.

(δ.) Exit is to be provided for the gases in the abdomen and thorax, either by means of a hollow needle, or an aspirator syringe. Care must be taken that exit is also given to the gas present in the intestines.

(ε.) This done, the abdominal and thoracic cavities are to be injected with what Richardson calls "zinc colloid," that is, zinc chloride dissolved in styptic colloid (20 grs. to ℥ j.).

(ζ.) A hollow needle is then to be passed into the skull through the nose, and the cavity injected with zinc colloid by means of a syringe.

(η.) The eyes and outer cavities are to be neatly closed with silk, the nostrils having been previously plugged with cotton wool saturated with zinc colloid, and the cavity of the mouth well brushed over with zinc colloid.

(θ.) The body is now to be evenly swathed in a bandage soaked in zinc colloid or carbolic, the hands and face being left exposed. It is then to be clothed, the hair arranged, and placed in a well-made shell.

Dr. Richardson gives numerous details as to how embalming may be carried out in cases where a post-mortem examination of the body has been performed. ("*Medical Times and Gaz.*," Jan. 30, 1875, p. 111.)

(C.) *Marini's* process of embalming ("*Brit. Med. Journ.*," 1873, II., p. 292), employed in the preservation of Thalberg's body, is said to be by the desposition of insoluble precipitates in the tissues by electricity (!).

(D.) Another process, suggested by *Ambrose Paré*, is worth recording. ("*Brit. Med. Journ.*," 1878, I.) The vessels are first of all to be drenched with cold water, then with alcohol in order to dry them, then with ether in order to dissolve the fat, and finally with a strong solution of tannin, or one composed of glycerin (14 parts), sugar (2 parts), and potassic nitrate (1 part). The body is then to be dried in a current of warm air from which all moisture has been removed by passing it over chloride of calcium.

Once more we refer to the two questions suggested by the various subjects we have been considering.

Question 1. *As to the signs of the reality of death.* This has been sufficiently answered and discussed.

Question 2. *As to the period of death from the inspection of a dead body.* Any opinion on this point must be founded upon the condition

of all the organs, the mode of death, and the surroundings of the body, including in the term "*surroundings*" the season of the year, the heat and moisture to which it has been subjected, the quantity of clothing worn, the depth of the grave in which it has been interred, etc. With slight alterations, we adopt for these determinations the rules laid down by Casper, which are as follows (Vol. I., pp. 15–40):—

(A.) *Signs of death present in bodies dead at the longest from ten to twelve hours.*

1. Complete cessation of respiration and circulation.

2. Loss of lustre in the eye, immobility of the pupil, and loss of the normal tension of the globe.

3. Inability to produce reaction unless it be contraction of muscles by stimuli, which reaction only continues so long as the stimulus is applied.

4. Extreme pallor (ashy whiteness) of the body. [Exceptions: jaundice, the yellow discolorations arising from the action of poisons, tattoo-marks, the edges of ulcers, bruises and wounds inflicted during life, extravasations (as in purpura), etc.]

5. Coldness after from eight to twelve hours.

6. A state (strikingly shown in the globe of the eye) of general relaxation and flaccidity (unless in the case of the muscles rigor mortis be present), with flattening of the nates, calves, etc., when subjected to the pressure of their own weight.

7. Rigor mortis.

8. Hypostases in the dependent or posterior portions of the body and of the viscera.

(B.) *Signs of death present in bodies, dead from two to three days.*

In addition to the preceding signs, we find—

9. Coagulation of the blood.

10. Rigor mortis may be present or may have passed off, a condition of general flaccidity together with incipient signs of putrefaction being apparent.

(C.) *Signs of death in bodies dead for more than three days.*

Except in very rare cases, there will now be signs of *putrefaction*. Exceptions may occur during very cold weather, or in the case of bodies preserved in ice, also after certain modes of death (as alcohol poisoning, etc.), or where some method of hindering decomposition has been employed.

At later periods mummification or the formation of adipocere may be found.

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ILLUSTRATIVE CASES.

[NOTE.—*The name in italics after the reference is that of the reporter. At the end of each case the page or pages are stated where a reference to the case in the text will be found.*]

1. **Ann. d'Hyg., 1832, I., 602.**—(*M. Marc.*)—Male, adult. Death from apoplexy. The man was seen to lean his forehead on his hands, in which position he died and stiffened. His friends thought he was asleep, no period of muscular relaxation having occurred. (Page 54.)

2. **Taylor's Med. Juris., I., p. 65.**—Female. Found dead, kneeling in an upright position, in the attitude of prayer. Death ascribed to apoplexy. (Page 54.)

3. **Virchow's Archiv., Band LI.**—(*Rossbach.*)—An account of how certain of the slain on the fields of Sedan and Beaumont retained the position and facial expression assumed by them before death. Thus it is recorded that a group of six soldiers were killed by a shell. In one case the head was carried off, but the face retained the expression of laughter. A second was found holding a cup from which he was drinking when the shot carried off his head. This condition lasted in some instances as long as twenty-four hours. Rossbach does not consider that in such cases the nervous centres must have been injured, nor that death was necessarily instantaneous. Rigor mortis, in his opinion, set in between the last moment of life and the first of death. (Page 54.)

[For similar cases see "*Lancet,*" Sept. 3, 1870, p. 344, and *Amer. Journ. of Med. Sciences*, Jan., 1870, Vol. lix., p. 87. (Dr. Brinton.)]

4. **Taylor's Med. Juris., I., p. 66.**—(*Recorded by Devergie.*)—In this case the man was found with his arm and hand stiffened, the pistol being uplifted, and pointed toward that side of the head against which it had been fired. It was manifestly a case of suicide, the hand and arm having stiffened in the last attitude of life. (Page 55.)

5. **Taylor's Med. Juris., I., p. 66.**—Death from Lime-Kiln Gases The man was found dead in the attitude of sleep. The left arm was raised,

supporting the head, whilst the right arm was semiflexed on the abdomen. (Page 55.)

6. **Taylor's Med. Juris., I., p. 66.**—(Case of Lord William Russell, murdered by Courvoisier, 1840.) The position after death in this case indicated that a struggle had occurred as the last act of life. (Page 55.)

7. **Taylor's Med. Juris., I., p. 66.**—The ice broke whilst a young man was skating. For a time he supported himself by resting with both elbows on the sound ice surrounding the broken portion, the lower part of his body only at this time being submerged. Eventually the ice on which he rested gave way, and he fell into the water and was drowned. The following day the body was recovered. The arms were found bent, and in the precise position in which he had rested on the ice the previous day. The position of his legs further indicated that he had exerted himself powerfully during the last moments of life to keep his head above water. (Page 54.)

8. **R. v. Ellison.**—(*Bodmin Assizes*, 1845.)—Hairs (gray and brown), corresponding in all respects to the hair of the prisoner, were found tightly grasped in the hands of the murdered woman. (Page 57.)

9. **Ann. d'Hyg., 1829, I., 465.**—(*Dr. Marc.*)—A snuff-box was found powerfully grasped in the hands of the murdered woman. (Pages 55, 57.)

10. **Taylor's Med. Juris., I., p. 65.**—Male. After death, a loaded pistol was found firmly grasped in one hand, and a second pistol, lately discharged, in the other. (Pages 55, 57.)

11. **R. v. Gardner.**—(*C.C.C., Oct.*, 1862.)—(See Case 69.)—The victim (a woman) died from a cut throat. After death a table-knife was found lying loosely in her right hand, but the back of the blade was toward the palm, and the weapon in the direction of the length of the body. It was shown that the chief cut could not have been self-inflicted with the *right* hand. [This was probably a case of murder.] (Pages 55, 57.)

12. **R. v. Heyward.**—(*Liverpool Assizes*, 1855.)—Female found dead with her throat cut. A razor, with one small blood spot only upon it, was found *loosely* held in the right hand. There was no blood on the hands, arms, or chest. The arms were folded across the chest, and *the back* of the razor was toward the person of the deceased. The wound was one which, if self-inflicted, must probably have been made by a left-handed person, its direction being from right to left. The jugulars, carotids, and windpipe were severed. (Pages 55, 57.)

13. **R. v. Saville, 1844.**—The prisoner was tried for murdering his wife by cutting her throat. In the deceased woman's hand was found a

razor, but it appeared to be very loosely grasped. There was no blood on the hand holding the razor. (The razor in this case had probably been placed in the hands of the woman after death.) (Pages 55, 57.)

14. **Case of Robert Reed.**—(*Edinburgh*, 1855.)—The prisoner was tried for the murder of his wife. In this case the remarkable attitude in which the body was found after death, and its condition of rigidity, gave rise to conflicting opinions. (For a detailed account see "*Taylor's Med. Juris.*," I., p. 71.) Verdict, "Not proven." (Page 55.)

[For similar cases where persons retained after death the position assumed by them during life, see Ogston, page 377.]

15. **Taylor's Med. Juris., I., p. 55.**—(*Dr. Chowne.*)—A still-born. The medical man saw the child three-quarters of an hour (during a part of which time it had been in a warm bath) after its birth. He found it quite rigid. (Pages 53, 59.)

16. **Taylor's Med. Juris., I., p. 55.**—(*Mr. Parkinson.*)—(Page 59.)
Case 1. An infant. Died during labor. Rigor mortis well marked the next day.
Case 2. The body of a dead child delivered by craniotomy. Exhibited strong rigor mortis.

17. **British Med. Journal, October 17, 1874, p. 493.**—(*Dr. Grigg.*)—Rigor mortis in an infant at birth. The child was certainly alive two hours before labor commenced, and seven hours before it was born. Hemorrhage was the probable cause of its death. (Page 59.)

[A similar case is recorded in the same Journal, pp. 551 and 707 (Dr. Young).]

18. **Taylor's Med. Juris., I., p. 55.**—(*Dr. Handyside.*)—Adult. Rigor mortis commenced in one and a half hours after death from suicidal cut throat, and whilst the body was warm. (Pages 50, 53.)

19. **Med. Gazette, Vol. 38, p. 351.**—Four laborers killed by lightning. The one who suffered most wore a goat-skin. The body exhibited well-marked rigidity after three hours. (Page 61.)

[See also "*Med. Gazette*," Vol. xlvii., p. 844, for a case of death from lightning, followed in twenty-eight hours by rigor mortis.]

20. **Taylor's Med. Juris., I., p. 57.**—(From "*Med. Critic*," Jan., 1863.)—(*Dr. Snow.*)—Three days after death the face of the corpse suddenly became red and suffused. (Page 72.)

[Similar case reported as having occurred in Dr. Taylor's personal experience.]

21. **Taylor's Med. Juris., I., p. 90.**—Trial of Mrs. Keir and her son for the murder of Mr. Keir. The charge was murder by strangulation, the chief evidence in support being a broad blue mark on the fore part of the neck. The question was whether the mark was a post-mortem hypostasis or the result of violence. The prisoners were found guilty. (Page 65.)

22. **Ogston's Med. Juris., p. 380.**—(Edinburgh, 1808.)—In this case cadaveric lividities were mistaken for bruises. The accused was acquitted on medical evidence. (Page 65.)

23. **Taylor's Med. Juris., I., p. 91.**—Male, æt. 33. Sudden death from morbus cordis. The man suffered from general dropsy. Eighteen hours after death various sized patches of discoloration were discovered on the dependent portions of the body, but the parts which had been subjected to actual pressure were white. The patches exhibited zones of different colors, such as commonly occur in a bruise inflicted during life. Further, on cutting into these patches, the layers of the skin and of the tissues beneath were found to be congested. (Page 65.)

[Note. The man was dropsical.]

24. **Edinburgh Med. Journ., Vol. LVIII., p. 497.**—(*Sir H. Marsh.*)—An evolution of light from the face stated to have occurred shortly before death. (Page 86.)

25. **Dublin Medical Press, Jan. 15, 1840.**—(*Drs. Donovan and Stokes.*)—Phosphorescence of face recorded as occurring after death. (Page 86.)

26. **Edinburgh Med. Journ., Vol. LXVI., p. 285.**—(*Dr. H. McCormack.*)—Child, æt. 16 months, suffering from dentition. The skin of the hips was noticed to be luminous. There was no odor of phosphorus, and no application had been made to the skin to account for the luminosity. (Page 86.)

27. **Taylor's Med. Juris., I., p. 98.**—Phosphorescence of a partially dissected body. (Page 86.)

28. **R. v. Palmer (1856).**—Poisoning by antimony. The body, which was exhumed after twelve months' interment, was in a good state of preservation. The poison had penetrated to the uterus and ovaries. (Page 77.)

29. **Case of Dr. Parkman.**—In this case Dr. Webster attempted, but failed, to dispose of Parkman's body by chemical reagents. (See Index.) (Page 78.)

30. **R. v. Manning and Wife—Tried for the murder of O'Connor.**—(*C. C. C., Oct.*, 1849.)—In order to destroy the body the prisoners

poured over it $1\frac{1}{2}$ pint of oil of vitriol, and subsequently covered it with fresh burnt lime. The body nevertheless was afterward found in a state of good preservation. (Page 78.)

[See also a case where lime retarded putrefaction, reported by Taylor, I., p. 103.]

31. **Taylor's Med. Juris., I., p. 111.**—

a. Male. Putrefaction set in after thirty-eight hours in a case of death from an accident. (September, 1855.) (Page 78.)

b. Male. Putrefaction set in after forty-eight hours in a case of death from fractured ribs. (September, 1855.) (Page 78.)

c. Male. An absence of putrefaction after forty-four hours in a case of death from phthisis. (September, 1855.) (Page 77.)

d. Male, æt. 26. Advanced putrefaction sixteen hours after death from typhoid (perforation of the ileum). (Weather cold and moist. November, 1855.) (Page 77.)

e. Male (very plethoric). Advanced putrefaction after thirteen hours. Death had been the result of accident. (November, 1864.) (Page 78.)

f. Male, æt. 35. Death from pistol-shot; lived six days. Slight rigidity after thirteen hours, when the internal decomposition was found to be advanced. (Weather cold and moist. December, 1854.) (Pages 62, 78.)

g. Male, æt. 50. Death occurred on the fourth day after an accident accompanied by loss of blood. Twenty hours after death the body was so decomposed that the face could scarcely be recognized. Putrefaction was very advanced both externally and internally. (Weather frosty. December, 1860.) (Pages 71, 78.)

h. **Med. Gaz., 1850, Vol. XLV., p. 17.**—Male, æt. 39. Sudden death. The patient was corpulent and intemperate. After sixteen hours putrefaction was found to be very advanced. After seventeen hours the gas issued in jets from every part of the skin when punctured. It was very offensive, and exploded when a light was applied. The gas did not contain H_2S or PH_3, but burnt like CH_4. When the skin of the scrotum was pricked, the gas burnt in a jet like C_2H_4 for about a minute. (October, 1849.) (Pages 70, 77.)

i. **Edinburgh Monthly Journal, Vol. LVIII., p. 501.**—Male: adult. Had been ill some days before death. After eight hours the body exhibited a condition of advanced putrefaction. The gas generated was inflammable, and burnt with a bluish flame. (Pages 70, 77.)

32. **Beck's Med. Juris., Vol. II., p. 45.**—(Case of Desha tried for the murder of Francis Baker.) Desha was seen with the deceased six days previously to his body (which then had a cut on the throat) being discovered. There was no appearance of putrefaction about the body at the time it was found, but it was a little stiff. It was placed in a warm room, and putrefaction commenced two days afterward. On this day the throat wounds bled, and the face and abdomen became swollen (November, 1824).

It is recorded that the hair had grown. The prisoner was found guilty.

Question—Was the state of non-putrefaction consistent with the prisoner having committed the crime six days previously? [Yes.] (Pages 74, 84.)

33. **The Trial of Mrs. Byrne for the murder of her husband.** —*Dublin, Aug.*, 1842.)—("The Trial of Mrs. Ellen Byrne, for the Murder of Mr. Augustine Byrne, specially reported by T. R. Dunckley," Dublin, 1842.)—"In August, 1842, Mrs. Ellen Byrne was tried at the Commission Court, Dublin, for the murder of her husband, Augustine Byrne, by strangulation, suffocation, or other violence. The prisoner and deceased, who were in a respectable condition of life, were in the habit of drinking to excess. On this occasion they had retired to their bedroom, and about four days after the deceased had been last seen alive, and eight days after they had been in the room, the body of the husband was found dead on the bed, while the wife was in the room. She professed not to know that her husband was dead, and sent for a medical man. From his evidence it appeared that when he first saw the body on Saturday evening (July 9th), it was so much decomposed, that he was led to believe the deceased had been dead at least four or five days. The face and neck were black, and decomposition had gone on to such a degree in these parts, as to obliterate, it was believed, any marks of violence that might have been there at the time of death. The right eye protruded, and the tongue projected between the teeth to about half an inch; the ears were black, the lips were swollen, and the fingers were contracted. There was a frothy liquid issuing from the mouth and nostrils in bubbles, and living larvæ were seen in these parts. The whole of the body was greatly swollen, discolored, and passing rapidly into a state of decomposition. When first seen deceased was lying on his face. There was a faint, heavy smell in the room. An inspection made the next day revealed the fact that putrefaction had taken place in all parts; but the head and neck were most decomposed; the black color of the skin appeared to decline as it got down to the lower part of the neck. Internally, the heart was empty, and the vessels of the brain were perfectly empty; the blood was fluid. Feculent matter had been discharged from the bowels before death.

"There were two medical questions in this case, on which the guilt of the prisoner rested: 1, When did the deceased die? and, 2, Was death to be ascribed to violent or natural causes? On Friday, July 1st, eight days before his body was found, deceased had retired to his bedroom with his wife, and during that time a large quantity of spirits had been taken to the room, and consumed by him, by his wife, or by both together. On Sunday, the 3d, the voice of deceased was heard, as if he and his wife were quarrelling. On Monday they were not seen. On Tuesday (July 5th) a man-servant deposed that he was called upstairs by the deceased, who spoke to him, and gave him half-a-crown to fetch whiskey. He then heard deceased's voice, and saw his bare arm through the partly opened door; but from the position in which he was placed, he could not see the whole of deceased's body. After this date, deceased was neither seen nor heard—he was found dead on the evening of Saturday (July 9th), his body being then in the highly decomposed state above described. On Wednesday (July 6th), prisoner left the bedroom for a short time, and closed the door. On Thursday (July 7th), and Friday (July 8th), she was seen at the door of the bedroom by the man-servant, and on the latter day by her maid-servant, and she was then quite sober, and spoke to them as usual. On Saturday (July 9th), at ten o'clock in the morning, she ordered the servant to bring up *two* cups of tea. Between six and eight o'clock on the evening of that day, she suddenly called to one of her sons, to turn the deceased on his back. On entering the bedroom, he found deceased dead, and his body as above described. As the prisoner had been in the bedroom alone with deceased, either living or dead, from the Tuesday when he was last seen until the Saturday, she must, it was alleged, have been cognizant of his death, if it had not been directly caused by some act on her part. The prisoner made two statements: first, that she slept in the bed on Thursday and Friday, and that deceased died on Friday. She subsequently stated that he died on Saturday, the day on which the body was discovered.

"From the state of decomposition of the body, two of the medical witnesses for the prosecution assigned a period of at least four or five days during which deceased must have been dead. Two declined to give an opinion as to the number of days, and one (the late Dr. Geoghegan) stated his belief that such changes might take place in from twenty-eight to thirty hours. A medical witness called for the defence deposed that he had seen a body as much decomposed twenty-four hours after death.

"On referring to cases elsewhere related, it will be perceived that the shorter period assigned by these two witnesses—one for the prosecution and the other for the defence—is quite within the limits assigned by experience, although instances of such rapid putrefaction are not common.

"In this case, however, it must be remembered that the dead body was shut up in a close room, at the hottest period of the year, and the cir-

cumstances were therefore most favorable to the process. Admitting that this was an exceptional instance of rapid decomposition, the changes described by the witnesses might have occurred within twenty hours of the time at which the body was discovered, thus carrying the death to the night of Friday the 8th, at the time when prisoner was, according to her statement, in bed with the deceased.

"The other question, as to the cause of death, gave rise to a conflict of opinion. On the one hand, it was alleged that the appearances in the body, *i.e.*, the black and decomposed condition of the head and neck, compared with other parts; the protrusion of one eye from its socket, and the projection of the tongue between the lips, as well as the absence of any natural cause of death, were medical proofs that deceased had died by strangulation, and not by any disease or accident. On the other hand, it was asserted that the deceased might have been accidently suffocated while helplessly intoxicated, by falling with his mouth on the pillow, or that he might have been carried off by a sudden attack of apoplexy or epilepsy. The discoloration of the face, the protrusion of the eye and tongue, and the discharge of fæces, might be accounted for by his dying during a convulsive struggle; while the two supposed indications of strangling afforded by the eye and tongue, might be simply the result of the advanced state of decomposition in which the body was found. All the witnesses were agreed that there were no marks on the neck to indicate death by strangulation; but this want of physical evidence was accounted for, by some of them, on the theory that all such marks would be completely obliterated by putrefaction. The heart contained no blood, and the vessels of the brain were empty; the blood in the body was fluid and dark colored. The state of the lungs is not mentioned, nor the condition of the larynx and air-passages, so that it is left uncertain whether any mechanical cause of obstruction existed in these parts. The emptiness of the heart, which was adverse to the theory of death by strangulation (asphyxia), was referred to the mechanical effect of gaseous putrefaction on the organ. The emptiness of the brain was left unexplained. It was inferred by most of the witnesses for the prosecution that the marks of manual strangulation on the neck externally, and the usual appearances of asphyxia internally, had existed at the time of death, and that these appearances had been destroyed by putrefaction. Those who adopted this view contended that the protruded eye and tongue were conditions which had resulted from strangulation alone, and that they could not be produced or removed by rapid putrefaction.

"The guilt of the prisoner rested chiefly on these two points. The facts showed, even allowing no more than twenty hours to have elapsed between death and the discovery of the body, the prisoner must have been cognizant of the death; and, unless hopelessly insensible from drink, which appears to have been disproved by the evidence, she would, it was suggested, if

innocent, have given an alarm. She ultimately called to her son, and no reason can be assigned why she did not call for assistance earlier. It was impossible to assume that she was speculating on the rapid decomposition of the body, and watching for the stage when marks of violence would be obliterated. No motive could be assigned for the murder, nor for her remaining shut up in the same room with her husband, as it was alleged, for four or five days. Under these circumstances, with the admission by some of the scientific witnesses that the protrusion of the eye and tongue might have been caused by putrefaction, the jury returned a verdict of not guilty. There was nothing to exclude the supposition that the deceased might have died in a convulsive fit from epilepsy, as the result of excessive drinking. In any case, it was obvious that the body had undergone rapid putrefaction. The greater decomposition observed in the head and neck might have arisen from the congestion of blood in the superficial vessels. As other causes besides manual violence may produce a congestion of the head and neck, the blackening of these parts in a highly decomposed body furnished no medical evidence of homicide. The protrusion of the eye and tongue did not strengthen the theory of strangulation, since it was properly admitted by some of the medical witnesses that these conditions were consistent with the effects of putrefaction in an advanced stage. There was, therefore, no evidence of a medical nature to show that deceased had died by violence; and, instead of drawing the inference that such evidence had existed and had been destroyed by putrefaction, it would have been safer to have said that the highly decomposed state of the body prevented any correct medical opinion from being formed. No opinion went the length of affirming that death was necessarily produced by violence; and the jury were properly informed by the learned judge (Baron Pennefather) that they were not to convict the prisoner on probability, however strong, or on a mere preponderance of medical opinion." (Pages 71, 72, 84, 85, 92.)

[The above account of this remarkable case, and the remarks thereupon, are quoted from "*Taylor's Med. Juris.*," I., p. 115.]

34. **Trial of R. v. Mahaig.**—(*Kingston Winter Assizes*, 1863.)—The following account of this case is quoted from "*Taylor's Med. Juris.*," p. 118:—"The body of a woman was found dead in a room, in an advanced state of putrefaction. The deceased and her lover, a soldier, had retired to a bedroom some days before, and had kept themselves there secluded: the soldier was found with his throat severely cut. This man was charged with the murder of the deceased, by strangling her with a rope, and the medical questions to be solved were: How long had she been dead? and, Did she die from strangulation, or any other cause? The medical evidence showed, that when the deceased was first discovered, on Friday, November 6th, at 6.30 A.M., she was lying on her back in bed, her body being covered with clothes as usual, the head and neck only being exposed. There

was a pillow lying loosely over the face. There was no rigidity, and the hands were not clenched. The upper part of the body, including head, neck, and shoulders, was very much decomposed. The skin of the face was so black that the features could not be described. The tongue was protruded and swollen. The lips were everted and blown up with gas. Gases escaped from between the tongue and lips with a slight hissing sound. The abdomen was enormously extended with gas, and at the lower part much discolored. On opening the cavity the intestines protruded. The liver was in a putrefied state. On cutting into the skin of the chest a large quantity of air escaped; the lungs were found collapsed, and the heart was empty and contracted. Owing to the putrefied condition of the body, the head was not examined. From the blackened and decomposed state of the upper part of the body, the medical witness formed the opinion that death had been caused by violence, and he inferred that deceased must have been dead for some time.

"According to the evidence, the prisoner and deceased took the bedroom as a lodging at a public-house on Tuesday, November 3d. The deceased was seen on that night about nine o'clock, as well as the following morning, Wednesday, November 4th. On the last occasion the landlady, who took the breakfast to the door of the room, saw her face in bed. She was lying still, and, as she did not speak, the witness could not say whether she was then living or dead. It was observed, however, that of the breakfasts taken up, which had been ordered for two the previous evening, only one was eaten. From that time deceased was not seen alive. The prisoner came down stairs on Thursday morning, November 5th, at nine o'clock. There was nothing unusual in his appearance or manner. He asked to borrow a razor to shave himself, but there was no razor in the house. Breakfasts were not taken up that morning; and the following morning, Friday, November 6th, as neither appeared, the room was entered, and the body of deceased was then found in the state described. The prisoner was lying on the bed with his throat severely cut; the wound had obviously been inflicted some hours, and had bled a great deal.

"From the time deceased was last seen living (on Tuesday night) about sixty hours had elapsed. Considering that the weather was close and damp, and the body shut up in a small room, there was ample time for the putrefactive changes described, to have taken place; although such a degree of putrefaction is rarely seen until after the lapse of three or four days in warm damp weather. It was therefore an exceptional instance of rapid decomposition, like those elsewhere described. As the prisoner alone was in the room with the deceased, he must have been cognizant of her death; and yet he gave no alarm. His statement was, that they had both resolved to die; that they had purchased poison on Tuesday, the 3d, and took it on the evening of that day, and that deceased died in his arms. In the afternoon, having left the room for a short time, he

found on his return a cord round her neck, which he removed. The highly decomposed condition of the body was consistent with his statements; for although one day might be sufficient for such changes, they are seldom witnessed in less than two days. This would place the death of the deceased on the night of Tuesday.

"The main question, however, was this: Had the deceased been strangled by the prisoner on that night, or did she die from any other cause? The putrefied condition of the body was consistent with either hypothesis, and it was a strong circumstance against him that he had remained in the room with the dead body. There was, however, an entire absence of motive for the alleged murder. The prisoner and deceased had been apparently happy together. No quarrelling or struggling was heard at any time by the people of the house. There were no marks of violence on her person indicative of struggling or resistance. It was proved, as prisoner had stated, that the deceased had, on the 3d November, purchased at a druggist's, under a false pretence, a threepenny packet of Butler's vermin killer. This contains about one grain of strychnia, mixed with soot and flour; and the paper wrapper of this packet, with the empty bag which had contained the poison, was found in the prisoner's possession. Several letters written by the prisoner, one apparently at the dictation or with the cognizance of deceased, referred to their mutual intention to destroy themselves; and another, dated November 4th, stated that deceased had taken poison, and had died in his arms. With these facts there was strong reason to believe that the deceased had really taken the poison which she herself had purchased, and had died from its effects. Assuming that muscular irritability had been exhausted by violent tetanic convulsions before death, and that the deceased had died in one of these convulsive fits with great congestion of the head, the rapid putrefaction and the blackening of the features from the decomposed blood in the vessels would then be explained. The empty and contracted state of the heart was also consistent with this view. The stomach was examined chemically by the medical gentleman who was first called in to see the deceased. He found it empty, containing only mucus with some black particles, the nature of which could not be defined. It was at first thought that it contained strychnia, but on making an analysis of the remainder of the stomach and the spirit in which it had been preserved, I (Dr. Taylor) found that it contained no strychnia, and that the chemical results which had led to this conclusion were owing to the coloring action of sulphuric acid on bichromate of potash in contact with organic matter. In the state in which the stomach was brought to me (Dr. Taylor), cut into two portions and macerated in spirit, it was impossible to determine whether it had originally contained starch or soot (the substances with which the strychnia in the purchased powder was mixed), or gin (the liquid in which the prisoner said the deceased had taken the poison). This negative result did not show that the

deceased could not have died from the effects of a small dose of strychnia (half a grain) such as would be contained in one-half of the packet which she purchased; for such a quantity might have been readily removed by absorption, especially as the poison was taken on an empty stomach. The theory adopted by the medical gentlemen who examined the body, was that deceased had probably taken strychnia, but that, before the poison had had time to operate fatally, she had been strangled by the prisoner by means of a rope placed round her neck. This, in their judgment, would account for the contracted and empty state of the heart and lungs: they assumed that as the strychnia was in the system, it would prevent that accumulation of blood in these organs which is considered to be characteristic of death by asphyxia. Another suggestion was, that assuming strychnia not to have been taken by deceased, the empty condition of the heart and lungs might be accounted for by the effect of gaseous putrefaction in the abdomen. A few ounces of bloody serum were found in the cavity of the chest, but no blood was present in the heart or great vessels connected with it.

"As the head was not examined, and the internal appearances of the chest did not support the theory of death by strangulation, it was sought to establish this view by the external appearances. Here, however, the same difficulty arose as in the preceding case. The advanced state of decomposition in the head and neck rendered the medical conclusions, to say the least, unsafe. The facts relied upon, to show that deceased had died from strangulation were,—1. The black and decomposed state of the head and neck, compared with other parts of the body. 2. Certain marks found on the neck, at the upper part, and chiefly on the left side. 3. The peculiarly moist condition of the head and upper part of the neck, and the drier appearance of the lower part, near the chest. 4. The enormous distention of the head, and the protrusion of the tongue between the lips.

"The first and third reasons assigned indicate, not the cause of death, whether by violence, disease, or poison; but simply an advanced stage of the putrefactive process, in a case in which death had taken place suddenly and the conditions were favorable to putrefaction. The surgeon who first inspected the body found, on the day following its discovery, three marks on the neck, corresponding to three similar marks at the back part. There was no abrasion of the cuticle in front, nor any indentation or depression, but at the back the cuticle was peeling off as the result of putrefaction, and serum exuded from it. On removing the integuments there was no appearance of escape or coagulation of blood beneath; and this is generally found in death from strangulation. The cellular tissue was much blown up with air (the gases of putrefaction). At the adjourned inquest before the coroner, while the facts were recent, the witness had thus described the appearances on the neck: 'On the external surface of the neck there were

two or three *indistinct* marks, most distinct on the left side. On removing the skin, there was not the least escape of blood, but here and there the muscular tissue was more discolored than the remainder.' Another witness, associated with this gentleman, who saw the body twenty-four hours later, described the marks as consisting of two or three lines of dark discoloration. There were no signs of violence beneath the marks, but the structures were of a darker color below. He further stated that there was much blood beneath the skin from the chin to the chest; and on the arms there were apple-green streaks from putrefaction in the course of the blood-vessels. The protrusion of the tongue was referred by both, not to putrefaction, but to mechanical pressure on the neck as a result of strangulation.

"A long clothes-line was found in the room, under the bed. This was proved to belong to the landlady, who stated that it had been lying a long time in the room before it was let to the prisoner and deceased. On it was one small spot of coagulated blood, as if from a wound, and some long female hairs. When these were compared with some taken from deceased's head, there was found to be no resemblance. It was suggested for the prosecution, that this rope had been employed by the prisoner as the instrument of murder.

"Dr. Taylor's evidence on this part of the case, the cause of death, was to the effect that, as the deceased was not seen in the act of dying, any medical opinion of the cause of death must be speculative; that there was nothing inconsistent with death from strychnia as alleged by the prisoner, while there were no medical facts on which the hypothesis of death from strangulation could be safely based. The internal appearances, so far as they were observed, were more consistent with death from strychnia, than with death by strangulation, a fact admitted by the two medical gentlemen who ascribed death to homicidal strangulation; that the non-detection of strychnia in the body was not inconsistent with the fact that a small but fatal dose had been taken by deceased (?); that a rigid state of the limbs in a dead body would not be found where putrefaction had advanced to such a degree as in this case. Further, the external appearances did not prove that violence sufficient to cause death by strangulation had been applied to the neck of the deceased. The marks of discoloration on the neck, with the protrusion of the tongue, might have arisen from extreme putrefactive changes. Had they been produced by the application of a cord, such a degree of violence as would have caused the tongue to protrude would have produced indentation and depression of the soft parts of the neck, with an effusion of blood in the course of the depression, and a ruffling or abrasion of the skin. There was no protrusion of the eyes; the tongue was not indented or bitten by the teeth, and the hands were not clenched as in death by violent strangulation.

"It was suggested by counsel that strangulation might have been

produced by other and less violent means than by the use of the rope, and the slight appearances thereby produced might have been obliterated by putrefaction. It was admitted that this might happen, but there were no medical facts on which such an opinion could be based. The appearances were all consistent with putrefaction in an advanced stage, without resorting to the assumption that any violence whatever, sufficient to cause death, had been done to the neck. In the defence it was urged that the prisoner and deceased had agreed jointly to take away their own lives: this was proved by the letters and their conduct. Deceased herself had purchased poison for this purpose, and had taken it, according to the prisoner's statement, on the evening of the day on which she procured it. Everything in the case was consistent with the theory of voluntary suicide, and of an attempted suicide by the prisoner in a state of despair. The powder containing the poison had disappeared, while the paper bag in which it was sold remained.

"In his charge to the jury, the learned judge observed that the great question for them to decide was whether the prisoner had any part in the death of the deceased. If they were of opinion that her death was caused by the rope, and by his act, then their verdict must of course be wilful murder. If they thought that death was caused by poison, then they would have to consider whether the deceased took the poison without any participation on his part, in aiding and abetting her act; and if she did, then they must acquit him. But if, in their judgment, the two agreed together to take poison, and took it together, and she died and he survived, then their verdict must be also wilful murder. The jury adopted this view, and found that the prisoner was guilty as an accessory before the fact, *i.e.*, that he was not guilty of murder by strangulation, but that he aided and abetted deceased in the voluntary act of self-murder." (Pages 71, 72, 85.)

34*. Indian Medical Gazette, Jan. 1, 1875, p. 4.—(*Dr. Harvey.*)—

(*a.*) Male, æt. 45. A fracture of the sternum without any appearance of union, bony or otherwise, and rupture of the intercostal muscles with extensive extravasation of blood at the seat of fracture, were clearly made out at the post-mortem on a body far advanced in decomposition. The appearances indicated violence before death, and moreover that the person did not long survive the injuries inflicted.

(*β.*) A comminuted fracture of the skull discovered in an exhumed and exceedingly putrid body. Prisoner convicted.

(*γ.*) A fractured skull with a penetrating wound of the abdomen clearly made out in "an enormously bloated and maggot-eaten body."

(*δ*.) Identity established in a body almost skeletonized, by the remains of a cartilaginous tumor of the neck.

(*ε*.) Identity determined from mere fragments of what had been a boy (æt. 8) by the hair on the back of the head and the absence of the left lateral incisors. Prisoner convicted. (Page 93.)

35. **Holliss v. Turner.**—(*Before V. C. Wood*, 1866.)—An attempt in this case was made to prove the death of one William Turner. A body was taken out of the river Wey ten days after the disappearance of a man named Etherington, and this body was sworn to as his corpse by his two sons, others stating that they believed it to be the body of William Turner. The body was buried as that of Etherington. Some months afterward the man Etherington turned up. The V. C. held that the evidence adduced satisfied him that the corpse buried as Etherington was the body of William Turner. (Pages 81, 84.)

36. **Taylor's Med. Juris., I., p. 127.**—(*Mr. Eager, of Guildford.*)—Male, æt. 70. This was a case of death by drowning. When the body was recovered it had probably been submerged for twenty-nine days (viz., during a part of January and February). The head, neck, and chest were covered with mud. The face and countenance were so perfectly preserved (although the skin was somewhat darkened in color) that there was no difficulty in its identification. There was no tumefaction. The skin of the hands and feet was thickened, white, and corrugated, but firmly adherent to the flesh. (Pages 81, 82.)

37. **Lancet, Sept. 30, 1876, p. 475.**—Body very little decayed after burial for six years. (Page 79.)

38. **Brit. Med. Journ., Dec. 14, 1872, p. 650.**—(*Mr. Mansar.*)—Description of the appearances presented by two children, (1) æt. 10 years, (2) æt. 14 months, after burial for seven months in a dry soil. [Arsenic was found, on analysis, in the bodies.]

In the elder child the soft parts of the nose had disappeared, the rest of the face being dry, and of a dark brown color. The brain was a mere pulp, and traces only of the eyes remained. The skin of the chest, thighs, and abdomen was of a reddish-brown color and mummified. The genitals were converted into adipocere. The sex was not distinguishable.

The face of the younger child was better preserved than that of the elder, but the soft parts of the nose had quite disappeared. In other respects the appearances presented by the two bodies were alike.

In both cases the lungs were more decomposed than any of the viscera. The heart of the younger child was in a good state of preservation. (Pages 79, 88, 91, 92, 97, 98.)

39. **Taylor's Med. Juris., I., p. 128.**—(*Mr. Harris, of Redruth.*)—Male, æt. 24. The body was recovered from the shaft of a mine, after having laid in 30 fathoms of water for twenty-six years (1828–1854). All the soft parts (excepting a small piece of fatty substance) were destroyed. The bones were firm and well preserved, but detached, and of a brown or black color. The skull was full of a brown soft substance, which had no smell. (Pages 81, 83.)

[The remains were identified by the brother of the deceased, chiefly by the boots and buttons, of which remains were found.]

40. **British Med. Journ., April 3, 1875.**—Remains of a skull and other adult bones recovered near Laurencekirk, and supposed to belong to a man that had been boiled alive near the spot in 1430. [N.B.—There seems to have been no good reason for this supposition.]

41. **British Med. Journ., July 6, 1878.**—Human remains found in a railway excavation at Ardrossan. The skull was injured during removal. (Page 85.)

42. **British Med. Journ., Aug. 31, 1878.**—Human remains found at Wigtown.

43. **British Med. Journ., Sept. 18, 1875.**—Account of certain coffins found intact, after thirty years' burial, at Greenwich. The bodies in some of the coffins were well preserved, the embroidery in one case being as unruffled and complete as though it had just come from the hands of the dressmaker. (Page 79.)

44. **Taylor's Med. Juris., I., p. 128, also Beck's Med. Juris., (5th edit.), p. 599.**—(*Case tried at Warwick,* 1805.)—The body of a man was recovered from the water (the case being manifestly one of suicide) five weeks and four days after he had left his home. A Commission of Bankruptcy had been taken out a few days *after* he was first missed. The question arose in this case—was the man drowned *before*, or *after*, the date of issuing the commission? because if it was *after*, the commission was void in law, and the property could not be seized.

Appearance of body.—The face was covered with a muddy slime. Putrefaction set in so rapidly that forty-eight hours after its recovery identification was impossible. The hair of the head could be separated from the scalp by a slight pull. The muscles of the buttock were adipoceratous. The other parts were firm and white. The clothes generally were well preserved, excepting the shirt and neckcloth, which had become rotten.

Question.—Did he drown himself on the day he left his house (*i.e.*, before the commission was issued) or at a *later* period (*i.e.*, after it was issued)?

The jury decided that the deceased was dead when the commission was issued. The bankruptcy, therefore, was superseded. (Pages 81, 88.)

45. Med. Press and Circular, Sept. 30, 1874, p. 290.—Female. Body recovered after being embedded in the bed of the Thames for two or three years. It was completely converted into adipocere, the whole of the internal organs being one solid mass, having the appearance of hard discolored wax. One leg was wanting. The head was found resting on the left hand. (Page 97.)

46. Lancet, 1873, I., pp. 583 and 498.—(*Pickering Murder.*)—In this case the body, after four months' interment in a dry place at the foot of a stick-stack, was found converted into adipocere. The ligaments of the wrist were incapable of supporting the weight of the trunk. Probably the rapidity of the conversion of the body into adipocere was due to the excessive rain that had occurred since the burial. Some hair was found grasped in one of the hands. (Pages 57, 97.)

47. Lancet, June 7, 1873, p. 817.—Account of human remains found near Omagh in a peat bog, about two feet from the surface. The body was partly covered over with a piece of oak. The structures were perfectly free from odor, and in a good state of preservation, as if tanned. They were of a black color, and as thick as buckskin. No bone of any kind was discovered. The nails, œsophagus, and mesentery were also well preserved. It is believed that the remains may have been in the bog for a century or more. (Page 80.)

48. Lancet, June 28 and Aug. 2, 1873, p. 917.—Human remains (female), with shreds of sackcloth, found near the village of Dervock, county Antrim, in a turf bank, ten feet from the surface. The tanned skin was well preserved, except that on the hands and head. The bones had lost all their solidity (except the carpal and metacarpal bones) whilst some of the shafts of the bones had altogether disappeared. Some of the teeth were found *in situ*, but they crumbled to dust as soon as touched. The integuments of the face, the ears, tongue, and pharynx, the tendons of the joints, more especially those of the wrist and arch of the foot, were perfect. A few hairs of a light reddish color were found at the back of the ear. The cerebral membranes and a small quantity of cerebral substance was also recovered, and appeared hard, as if it had been steeped in an acid. (Page 80.)

49. Casper, Vol. I., p. 33.—Examination, forty-eight hours after death, of the bodies of fourteen men (ages 24 to 30), all of whom had met the same death (from the rifle) and died at the same time. In no case did the signs of putrefaction found in one, resemble those found in another. (Page 84).

50. Casper, Vol. I., p. 33.—The bodies of two people (æt. 50 and 60), suffocated at the same time by carbonic oxide, were examined on the

fourth day after death. The body of the man (who was thin) was putrid, whilst that of his wife (who was stout) was quite fresh. (Page 84).

51. **Casper, Vol. I., p. 52.**—Inspection of a human fœtus that had been buried for about a year in moist garden soil. It was quite black, and the head had dropped off. The sex externally was not recognizable, but the uterus was in a state of perfect preservation, and in its proper position. The muscles of the trunk and extremities were converted into adipocere. (Page 92.)

[At page 41 (Casper) a case is mentioned where a fœtus was found changed into adipocere after seven months' burial in a garden.]

52. **Casper, Vol. I., p. 53.**—A girl, drowned in a privy, was recovered after an interval of nine months. The skull, lower jaw, and the greater part of the lower extremities, were bare, the connecting ligaments of the joints being partly separated. The uterus, however, was well preserved, and the medical jurist (Casper) was able to say that it was of virgin size, and unimpregnated. (Page 92.)

53. **Casper, Vol. I., p. 54.**—Inspection of the body of a new-born female child, which had been for a long period immersed in water, and probably met its death by drowning. The remains of the umbilical cord ($1\frac{1}{2}$ inch) were mummified. All the abdominal organs had disappeared except the uterus. (Page 92).

54. **British Med. Journ., May 1, 1875, p. 575.**—(*Dr. Holland.*)—Suicide by hanging. The man was cut down after one hour's suspension. As the rope was slackened, "air escaped from the thorax through the larynx, and a prolonged and rather loud groan was the consequence." He was undoubtedly dead at the time. Dr. Holland says, "the suicide braces his body for the final throw by taking in a deep breath, and when hanging is the method adopted, the constriction of the air-passage is too immediate and effectual to allow this air to escape; but when the rope is relaxed the lungs and thorax contract with sufficient force to occasion a groan, even an hour after death."

55. **Med. Press and Circular, May 13, 1874.**—Reported premature burial of a young woman. Interment said to have taken place six hours after the supposed death. (Page 25.)

56. **British Medical Journal, Jan. 21, 1871, p. 71.**—A case where an infant was nearly buried alive. It was heard to cry as the coffin was being carried to the cemetery. (Page 25.)

57. **British Medical Journal, December 8, 1877, p. 819.**—A woman in a state of trance buried alive. The Appeal Court at Naples sen-

tenced both the doctor who signed the certificate and the mayor who authorized the interment to three months' imprisonment, "for involuntary manslaughter." (Pages 25, 33.)

58. **Philadelphia Medical Examiner, October, 1850, p. 599.**—Male, æt. 33. For eight minutes no heart sounds could be detected. After twenty minutes the pulsations became regular, and the man opened his eyes. (Page 27.)

59. **Medical Times and Gazette, 1863, I., 396.**—(*Dr. Cousins.*)—Male, æt. 43. The man was subject to occasional and sudden attacks of long persistent sleep (five days and nights being the longest, and two days the average period), from which it was difficult to awake him. In this state the following symptoms were noted:—Skin pale and warm; limbs relaxed; pulse slow and feeble; respirations eight or nine per minute, and almost imperceptible. Secretions suppressed; no food taken. He usually awoke suddenly, remembering the events that happened before he fell asleep, but without the slightest consciousness of the lapse of time. (Pages 28, 32, 33.)

60. **Edinburgh Monthly Journal, April, 1845, p. 307.**—(From "*Gazette Médicale,*" January, 1845.)—Female, æt. 36, married. Subject at intervals of from two to twenty days to sudden attacks of long sleep, from which she could not be roused. These lasted from two to seven days, five days being an average period. The respiration, circulation, and temperature during the periods of sleep were normal. The eyes during the time were fixed upward, the pupils being insensible to light. Evacuations suspended. She usually awoke suddenly, but appeared to be unrefreshed by the sleep. (Pages 28, 33, 35.)

61. **Lancet, 1870, I., p. 12.**—Female, æt. 20. Cataleptic state lasting for eight weeks. The temperature at one time fell so low that she was thought to be dead. (Page 33.)

62. **Medical Times and Gazette, 1871, I., p. 287.**—Female, æt. 17. Profound sleep and stupor, with intervals of waking. (Page 33.)

63. **Lond. Med. Record, 1875, p. 333.**—(*Case at Cochine Hospital, Paris.*)—Female, æt. 24, unmarried. Extreme stupor (catalepsy). Breathing imperceptible; lips pink; trunk and limbs completely relaxed. When the fingers were placed in the glottis, it did not provoke cough, nor did she feel when the skin was pricked. About the sixth day the patient's muscles became tense and hard. Throughout this condition the action of the heart was clearly audible. (Pages 28, 32, 33.)

64. **Lancet, 1867, II., p. 275.**—(*Dr. Hingston.*)—Female, æt. 24, married. Cataleptic condition. Thought to be dead, there being at one

period of the case a death-like coldness and pallor. The pulse was imperceptible, and the limbs rigid. The eyes were upturned, and the pupils were uninfluenced by light. The respirations were so slow and slight as not to dim a looking-glass. Recovery took place after four hours. (Pages 28, 31, 33, 35.)

65. **Lancet, 1877, I., p. 905.**—(*Dr. O'Neill.*)—Female, æt. 18. Cataleptic condition. Became insensible. The heart's action was imperceptible, the respirations noiseless, and the muscles rigid. (Pages 27, 28, 33.)

[See also **British Med. Journ., 1876, I., p. 722.**—(Semi-cataleptic state occurring in a male (adult) after a mental shock, recorded by Dr. Sturges.) **British Med. Journ., 1878, I., p. 635.**—(Case recorded by Dr. Gairdner, of abnormal disposition to sleep in a girl.) **Lancet, 1880, I., p. 923, and 1881, I., 66.**—(The case of the sleeping girl (æt. 21) of Turville, recorded by Mr. Hayman.) **Medical Times and Gazette, 1870, I., p. 103.**—(Case of extreme lethargy for two months in an adult male.) **British Med. Journ., 1872, II., p. 167, and Med. Times and Gazette, 1874, II., p. 489.**—(Account of the sleeping disease observed in Africa amongst the natives.) **Lancet, 1870, I., p. 586.**—(*Dr. Handfield Jones.*)—(Case of epileptic stupor, lasting twenty-five days, and terminating fatally.) And also, by the same reporter, **Medical Times and Gazette, 1875, II., p. 184.**—(A case of hysterical trance in female (æt. 17), lasting for twelve days.) **Edinburgh Med. Journal, Vol. XVII., p. 29.**—(*Dr. Jameson.*)—A case of trance in female, æt. 16. **Med. Times and Gazette, 1872, II., p. 522.**—Prolonged sleep for seventy-one hours, in a male, æt. 25. **Amer. Journal of Med. Science, Vol. LIX., p. 245,** recorded in **Gaz. des Hop., Nov. 2, 4, 9, 11, 1869.**—(*M. Legrand du Saulle.*)—Male, æt. 32. A seven months' sleep, simulating death.]

66. **Taylor's Med Juris., I., p. 137.**—(*Case recorded by Briand.*)—The body of a woman was exhumed after eleven years' burial. It was found to be reduced to a skeleton, but the third, fourth, fifth, and sixth cervical vertebræ were held together by dark-colored decomposed flesh, whilst portions of a cord around the neck were well preserved. The length and color of the hair, the state of the teeth, and the form and length of the bones were recognizable. A ring was found on one of the finger-bones, by which means identity was established. (Page 80.)

66*. **Taylor's Med. Juris., I., p. 140.**—A body recovered from a cesspool was found to be completely converted into a skeleton after eight or nine months' submersion. (Page 83.)

67. **Taylor's Med. Juris., I., p. 140.**—Child, æt. 8, exhumed after 16 months' burial. The bones were supposed to be those of a dog until the skull, with the hair upon it, and the lower jaw, were discovered.

These, together with certain articles of clothing found, served to establish sex and identity. (Page 80.)

68. **R. v. Spicer.**—(*Reading, March*, 1846.)—In this case a man was tried for the murder of his wife. The woman had suffered violence, and was heard to fall down stairs at 12.30 A.M. At 9 A.M. she was found perfectly cold and rigid. It was argued that death must have occurred about the period when the fall was heard, and that the prisoner's statement therefore, that he saw his wife alive at 4.45 A.M., was untrue. (Page 38.)

69. **R. v. Gardner.**—(*October*, 1862.)—In this case a woman was found murdered, having lost a considerable quantity of blood from a wound in the throat. She was rigid and cold when discovered. She was lying on a wooden floor, covered only with a petticoat and chemise. Evidence was given to prove that she had been dead four hours. (Case 11.) (Page 43.)

70. **Ogston's Med. Juris., p. 370.**—(*Quoted from the "Lancet."*)—"In October, 1840, a servant girl, who had retired to bed in apparently perfect health, was found the following morning, as it appeared, dead. A surgeon who was called pronounced her to have been dead for some hours. A coroner's inquest was summoned for four o'clock, and the reporter and the surgeon who had been called in to the girl were ordered to inspect the body previous to its sitting. On proceeding to the house for this purpose at two o'clock, the inspectors found the girl lying in bed in an easy posture, her face pallid, but placid and composed, as if she were in a deep sleep, while the heat of the body had not diminished. A vein was opened by them, and various stimuli applied, but without affording any sign of resuscitation. After two hours of hesitation and delay, a message being brought that the jury were waiting for their evidence, they were forced to proceed to the inspection. In moving the body for this purpose the warmth and pliancy of the limbs were such as to give the examiners the idea that they had to deal with a living subject! The internal cavities, as they proceeded, were found so warm that a very copious steam issued from them on their exposure. All the viscera were in a healthy state, and nothing was detected which could throw the smallest light on the cause of this person's death." (Pages 25, 34, 42.)

71. **Ogston's Med. Juris., p. 371.**—"One morning, in the summer of 1840, I (Dr. Ogston) was sent for to Littlejohn Street, Aberdeen, to see a lad of 17, who had just fallen down in the street, when on his way to a workshop in the neighborhood. He had immediately before left his parents' house in good health and spirits. The death appeared to have been instantaneous. Finding that nothing could be done, I left as soon as I perceived that he was really dead. On the afternoon of the same day I

was again sent for by the lad's mother, who stated that she had been deterred from proceeding to dispose of the body by observing that it did not become cold, as might have been expected had he been really dead; that the limbs were still supple; and that within the previous half-hour the color had returned to his cheeks. In short, she expected that he was about to come to life again. These statements were undoubtedly correct, and it was my painful duty to make the poor woman aware that all this was owing to the very rapid approach of decomposition in this instance, which, by next day, was fully developed in the body, the increased temperature still continuing." (Pages 26, 42.)

72. **Lancet, Dec. 6, 1879.**—(*Dr. Kelly.*)—Boy, æt. 16. Case of poisoning by ʒ iij. of prussic acid.

The following is the account of the post-mortem ophthalmoscopic examination in this case by Dr. Buzzard: "The usual brilliant red glow from the choroid was entirely wanting, and its place was occupied by a very pale violet-grey tint. The optic disc, of a dull grey white tone, was very ill defined. The retinal arteries could be discerned with the greatest difficulty, as exceedingly narrow threads. The veins, on the other hand, were easily traced, but appeared to be unevenly or imperfectly charged with blood. The observation was somewhat obstructed by a peculiar broken-up-like condition of the media—whether of the cornea, lens, or vitreous, I could not determine—which gave one the idea of looking through cooked tapioca." (Page 37.)

73. **Indian Med. Gazette, July 1, 1876.**—Female, æt. 25. Drugs given to produce abortion. Death occurred without delivery. A four-months' fœtus was expelled from the uterus after death. (Pages 47, 72.)

[A case also mentioned of a seven-months' fœtus being expelled, five days after death, during the transport of a body. Also of the inversion of the non-gravid womb by the force of the gases of putrefaction. *Vide supra.*]

CHAPTER III.

PERSONAL IDENTITY.

General Considerations.—Details for the Consideration of the Medical Jurist (A.) in Cases where a person is alive or has recently died; (B.) in Cases of the Discovery of Mutilated Remains; (C.) in Cases where Portions only of a Body are found; (D.) in Cases where a Body has been Burnt.—Questions suggested by the Discovery of a Complete Skeleton or of Isolated Bones.—Age, Stature, Race, Likeness, Congenital Peculiarities, Hereditary Diseases, etc., in relation to questions of Identity.—Marks left by the Hands and Feet.—Cicatrices and Tattoo Marks.—Hair and Fibres.—The Teeth.—Stains.—Handwriting and Varieties of Ink.—Sight and Hearing.—Tabular Statement of Details to be Recorded in Cases of Disputed Identity.

(Illustrative Cases, page 221.)

Of whom is this the body?—This question may arise (as in the case of Dr. Livingstone) where a body is brought from abroad, and doubt exists whether the remains are those of the person they are stated to be. Further, it is one of the questions specially submitted at every inquest to the jury for their consideration. Inquiries of this nature may have to be conducted on mutilated remains, or even on isolated bones. Hence such questions as the probable age, sex, stature, cause of death, period of death, etc., of the individual of whom the remains form a part, may be submitted to the medical jurist, to help elucidate the question of identity.

But the personal identity of the *living* is a yet more frequent subject of discussion than that of the dead, constituting, as it often does, an essential connecting link in a criminal trial, and the entire subject-matter of dispute in a civil cause. Thus, a man who has committed a crime leaves the country, and afterward returns: the authorities charge him with the offence, to which he pleads mistaken identity. Or again, a person, after many years' absence, returns home and claims as rightful heir, title and property: unrecognized by the home relatives, they dispute the relationship and kinship of the claimant. As a rule in such cases the decision of the court turns more on general than on scientific evidence; nevertheless, scientific evidence is frequently re-

quired, and oftentimes involves the most subtle of subtle scientific questions. (*Cases* 7 to 10, 14, 15.)

Thus, the precise nature of various corporeal defects—or the cause of sundry marks or cicatrices found on the body—or the question how far the disappearance of cicatrices known to have existed on the real person may be capable of scientific explanation, may constitute the very gist of a case. The medical expert further will be expected to be familiar with the various scientific investigations and inquiries that have been instituted from time to time respecting natural and unnatural growths, and with the recorded observations relating to the effects of age, accident, climate, occupation, and so forth, on individuals at different intervals of time and at different periods of life. These details it will be his duty, as a medical jurist, to apply to the special case under inquiry.

Cases of identity are frequently complicated by the fact that the great majority of people are untrained in minute observation. Thus, one part of a family will describe an absent relative as having very dark hair, whilst another part, with equally good faith, will assert that when last seen he had light hair. Even photographs help but little in this respect, complexion, general appearance, depth of tint, and so forth, depending far more on such details as the after touching-up of the negative, the time of its exposure, and the ease with which it prints, than they do on the face and complexion of the sitter. Further, the recognition of a well-known friend with whom we have had daily intercourse, by a carte-de-visite taken many years previously, is often far from easy. And this suggests the remark that, in all cases where photographs are required in a court of law, the negatives themselves should if possible be called for and produced. The tricks that a skilful photographer and toucher-up can play with a negative, render prints comparatively valueless as evidence. I have known a volume of smoke appear in a print as issuing from a chimney, and used as evidence of the existence of a nuisance, when no smoke existed in the original negative. In criminal cases where questions of identity arise, two additional points frequently complicate the inquiry, viz., (1) that the prosecutor may have seen the prisoner for a few seconds only, and that by an imperfect or instantaneous light (such as a gas lamp, the flash of lightning or of a pistol, etc.); and (2) that criminals are well-known adepts at personal disguisement.

Questions of identity, again, often occur in cases of infanticide and of the exposure of new-born children. A variety of circumstances frequently combine in such cases to render positive identification a matter of the greatest difficulty. Thus, the child may, in the first in-

stance, have been found by boys in the street, who deliver it up to a policeman. When the child is afterward shown them they are unable to identify it, and are probably ignorant even of the sex. A medical man, in such case, should not commence the post-mortem until either the body has been identified or every effort to identify it has failed; and further, if compelled to commence the autopsy, it is advisable that the face should be as little disfigured as possible, and every minute point of detail recorded. (*Case* 5.)

Bearing in mind the many questions involved, it will be understood why the subject of the personal identity of the living and dead should be one beset with difficulties.

It will be convenient, in the first place, to generalize briefly on the principal matters to which our attention, *re identity*, should be directed in different cases, and afterward to discuss separately and in detail, some of the chief points that require further consideration.

(A.)—Identity in the case of a living person, or of a body that has been dead a short time only.

(1.) *Age* (p. 136).—It may be of importance in establishing identity to fix the probable age of the person. In the case of children, the size, development, and condition of the epiphyses, and in the case of adults, the hair and teeth, and the condition of the alveolar processes, demand special attention. (*Case* 13.) The greatest possible caution, however, in attempting to fix the age of a person is necessary. (*Case* 37.)

(2.) *Sex.*—Cases of doubtful sex will be discussed in detail in Chapter VI.

(3.) *Trade, character of work and occupation of the person.*—Thus, the existence of horny hands denote that the person has been accustomed to hard manual labor (*Case* 31), whilst soft pliant hands, wanting in muscular development, indicate employment of a different character. Certain stains on the fingers (such as silver stains commonly found on the hands of photographers, etc.), should be recorded as suggestive of the business in which the person had been engaged.

(4.) *Complexion.*—In *Case* 13 a difference in the complexion of two persons proved of importance in determining identity, the murdered woman being proved to have had a sallow complexion, whilst the woman with whom she was confused was of a dark complexion. (*See* also *Case* 36.)

(5.) *Likeness and general type of face* (p. 150).—Type of face constituted a question of great importance in the Tichborne case (*Case* 4), the flat broad nose, broad nostrils, badly formed ear lobules, and blue eyes sworn to as existing in the real Roger, being scarcely consistent with the straight aquiline nose, well-formed nostrils and ear lobes, and the brown eyes of the claimant. (See also *Cases* 6 to 10.)

As regards identity from likeness after death, there are many circumstances that may render recognition, even by the nearest relatives, a matter of the greatest difficulty. (*Case* 29.) Thus, the expression, which usually appears calm and placid during the after-death period of relaxation, may become drawn and painful during the stage of rigidity, both the one and the other being equally unnatural. Identity by likeness fourteen days after putrefaction has set in, is as a rule practically impossible, although it must be admitted that exceptional cases occur where likeness can be clearly established after long and almost indefinite intervals. (Pages 34, 71, 81.)

The value of photography, as we have already said, must not be overrated. People change greatly by time, and the lenses of cameras are not uniformly perfect. (Page 125.)

(6.) *Race* (p. 149).—This may in some cases be determined. (*Case* 31.) The color of the skin, be it natural or the result of disease, or of the action of drugs, should be accurately recorded at a post-mortem.

(7.) *Hair* (p. 169).—The color, amount, general character, and length of the hair may prove important in determining both the individual and the sex. (*Cases* 13, 35, 41, 57, 59, 62, 63, etc.) But here certain points are to be noted:—

(α.) The color of the hair may be altered by dyes. Thus black hair may be rendered light colored (*Case* 65), and light hair may be dyed.

Any hair on which evidence has to be given, should first of all be thoroughly washed with water, and its *color* and *tenacity* in this condition recorded. Afterward a portion should be digested in nitric acid, and the acid liquid tested for silver, bismuth, and lead. The color of the hair after treatment with acid should again be taken note of.

(β.) Any hairs found in a coffin should be examined, to determine if possible whether or not they are human.

(γ.) Any hair found either in the hands or free about a body, should be carefully preserved and properly mounted in Canada balsam for microscopic examination. The correspondence or the non-correspondence of such hairs with the hair of the deceased or with that of an accused person, may constitute evidence of great importance.

(δ.) A question arises here, Does the hair grow after death? (*Case* 71.) (Page 180.)

(8.) *Nails.*—The nails resist decomposition an unusually long time. Their length and any peculiarities of growth should be carefully recorded. (*Case* 27.)

(9.) *Stature and Girth* (p. 141).—This constituted a subject of discussion in the Tichborne case. (*Case* 4.) Could the real Roger, who at the age of twenty-one was slim, 9 stone in weight, having narrow hips, thin straight legs and long bony fingers, develop within twelve years into a huge man like the Claimant?

(10.) *Changes effected by time, exposure and hardship on the face and person* (*Cases* 4 and 8), *and* (*in the case of the living*) *on the mind and memory.*—(*Case* 4.)

(11.) *Scars, etc.* (p. 157).—Tattooes are most commonly found on the arms of sailors and of the idle classes. The marks of nævi, of skin discolorations, of the lash, of bleeding, cupping, branding and setons, also marks of previous diseases, such as adhesions from pneumonia, skin diseases, scrofulous ulcers, small-pox, and syphilis, diseases of the teeth, etc., must be accurately recorded. (*Cases* 3, 4, 5*a*, 17, 18, 19, 20, 21, 23, 24, 26, 35, 38, etc.)

Questions relating to the permanence, the nature, and the cause of scars are often important. Thus a person may assert a scar to be due to one cause which is manifestly due to another. (*Case* 3.)

(12.) *Deformities, Congenital Malformations, etc.*—The shortening of a leg, such as would cause lameness or a peculiar waddling in the walk (*Case* 28), the known absence of certain parts or organs (*Case* 15), evidence of spinal disease, of wens, pimples, warts, or moles (*Cases* 28, 29, 30, and 38), of uterine malformations (*Case* 31), etc., may prove important.

(13.) *Injuries.*—The existence of old (united or ununited) fractures, marks of wounds, etc., may constitute important evidence. (*Cases* 2, 16, 47.) The probable *age* (*Case* 1), and the precise *position* of a wound (*Case* 11), either in relation to blood spots or to other injuries inflicted on the body or clothes, may require to be determined in cases of disputed identity.

(14.) *Pregnancy.*—(*Case* 35.)

(15.) *Clothes, rings, and other articles of jewelry, contents of pockets, etc.*—(*Cases* 36, 51.) All matters of detail connected with these, such as marks on linen, etc., should be noted with the most exact accuracy. (*Case* 28.) Articles likely to be matters of evidence should be preserved and marked so that afterward they may be easily identified.

(16.) In the case of the living it may be important to note peculiarities of speech, such as lisping (*Case* 16), stammering, inability to pronounce certain words or letters, or peculiarities of pronunciation.

(17.) In the case of dead bodies all such details as smears of tar, paint, etc., either on the clothes or body, should be recorded as likely to throw light on the identity of the person or help otherwise in assisting justice. (*Case* 38.)

(B.)—Identity in cases where mutilated remains, or a portion only of a body has been recovered.

As a rule, science in its most elaborate refinements, fails to dispose entirely of a dead body. (*Case* 34.)

The following points (in addition to those mentioned above) need consideration:—

(1.) *How far the several parts fit together.*—By carefully noting the correspondence or otherwise in the bones, muscles, and blood-vessels of the several pieces (some of which may be found in one place and some in another), we may be enabled to determine whether they belong to the same body, or to different bodies. (*Cases* 28, 31 to 33.)

(2.) *Age.*—It may often be possible to determine the age, even from mutilated portions of a body (*Case* 38), although in all such cases a very guarded opinion should be given. (*Case* 37.)

(3.) *Stature.*—This may be judged approximately by the relationship generally known to exist between the height of a person and the length of certain bones (p. 147). (*Cases* 34, 36, and 38.)

(4.) *Injuries likely to cause death.*—Thus in *Cases* 35, 36, and 38, the nature of the injuries found on mutilated remains, respectively pointed to the form of violence inflicted on the body during life.

(5.) *Method of Mutilation.*—In cases of mutilation, the public invariably suggest medical students as the culprits. It must be remembered, however, that medical students in dissecting do not hack or mangle a body, but rather cut carefully so as to preserve muscles and blood-vessels—that they do not stab or otherwise treat a body in such manner as to simulate acts of violence—that they do not make away with the parts specially necessary for identification—and, lastly, that they do not receive subjects for dissection with their clothes on. (*Case* 36.)

It may be worth mentioning that the method of, and the instrument used for mutilating a body, *e.g.*, whether it be a small or a large knife, a chopper, a fine or a coarse saw, etc. (*Case* 38), may be suggestive. Again, the presumption that a butcher in mutilating a body would probably do so with less mangling than most people, proved of importance in one case.

(6.) *The treatment to which the parts have been subjected after mutilation.*—(*Cases* 35, 36, etc.)

(7.) In all cases of mutilation every minute detail connected with the teeth (if the head be recovered) should receive special consideration. Their number, arrangement, state of decay, worn appearance (*e.g.*, by constantly holding a pipe), or the presence of artificial teeth (*Case* 34), should be noted. If any teeth have been removed, careful note should be taken whether their removal was, or was not of recent date. It is advisable, in order to avoid possible doubt or discussion hereafter on these points, that a cast of the mouth be taken before the remains are finally buried.

(C.)—Identity in cases where an entire or an incomplete skeleton has been discovered.

In addition to what has been already said under A and B, the following points are worthy of note:

(1.) *The extent to which destruction of the soft parts has progressed.* —This may at once settle the non-identity of the remains. (*Case* 47.) Thus supposing a body after prolonged burial be found completely reduced to a skeleton, and it be stated that the individual in question had been seen alive two or three months previously, the identity is disproved by the impossibility of a body becoming completely skeletonized after burial in earth for such a short time.

(2.) *The surroundings of the bones.*—Thus buttons or articles of jewelry (as a ring) (*Case* 41), or portions of boots, etc. (*Cases* 48 and 50), may be found long after the soft parts of a body have rotted.

(3.) *Are certain bones human?*—Mistakes in answering this question are recorded, and suggest the necessity for great caution. (*Cases* 40 and 51.) The medical jurist in all such cases should content himself with saying whether bones submitted for examination in his judgment be human, rather than (if they be not human) venturing an opinion as to the precise animal to which they belong (p. 133).

A further question (supposing the bones to be human) will occur, viz., *Are they the bones of one, or of more than one individual?* (P. 134.)

4. *Age.*—If the remains be those of a person under puberty, the size, length, and general appearance of the bones, the condition of the cartilages of the ribs and sternum, and the state of the epiphyses, will furnish data by which to determine the probable age. Age becomes a matter, however, of far greater difficulty after the advent of puberty. The condition of the alveolar processes will prove a certain guide at more advanced periods of life. (*Cases* 49, 50, 51, and 53.)

(5.) *Sex.*—The bones where the muscles are attached exhibit a

more marked roughness in the male than in the female. The pelvis, however, will be our chief guide in determining sex. (*Cases* 41, 49, and 50.) But it is important to remember that the pelvis is very little guide in this respect before puberty, or at any rate before the age of eight or ten (*Case* 51), whilst even after puberty, unless the entire pelvis be recovered and its sexual characters be well marked, a very guarded opinion only should be given. (*Case* 49.)

(6.) *The Teeth.*—*Cases* 12, 41, 42, and 52, show the importance of noting all particulars respecting the teeth in cases of disputed identity.

(7.) *The Hair.*—Hair may be found in a coffin long after the soft parts have decomposed, and where nothing but the skeleton remains.

(8.) *Malformations of bones.*—Cases are recorded where spinal malformations and bowed legs (*Case* 42), the existence of supernumerary toes and fingers (*Case* 44), and certain peculiarities of bones (*Cases* 12 and 45), proved important in establishing identity where a few bones only were recovered.

(9.) *Diseases of bones.*—On several occasions the discovery of an anchylosed condition of joint, of spinal disease (*Case* 45), etc., have proved, or helped prove, identity. The existence of rickets, of syphilitic disease, and softening of bones should be carefully noted.

(10.) *Injuries to bones.*—Injuries to the skull (*Cases* 42 and 43), and to other bones (*Case* 50), should be sought for. Further, it should be noted how far the appearance of such injuries suggests the instrument with which they were inflicted and whether they were likely to have caused the death. (*Case* 50.)

And here two cautions are suggested:—

(*α*.) Not to mistake accidental injuries occurring to the bones during exhumation for acts of violence inflicted during life. (*Case* 43.)

(*β*.) Not to confound deficient ossification of the skull or unclosed fontanelles for criminal violence. (*Case* 46.)

(11.) *Pregnancy.*—If the bones of a fœtus be found in the same coffin with those of a female skeleton, the fact is suggestive of the probable pregnancy of the woman at death. The absence of such fœtal remains in the coffin has been used as an argument against the body exhumed being that of the individual supposed, seeing that at death the woman in question was known to have been far advanced in pregnancy. (*Case* 52.) It must be remembered, however, on the one hand, that undertakers frequently bury still-borns indiscriminately in coffins with adults, and on the other hand, that fœtal bones would probably be disintegrated long before the bones of an adult.

(D.)—Identity in cases where burnt remains have been discovered.

The evidence derived from burnt remains must, as a rule, at best be unsatisfactory. Nevertheless the age of a bone, and the state of the epiphyses, may be determined almost as well after, as before calcination, *if the burnt bone be entire.* The presence of phosphate of lime in large bulk in an ash, if that be all remaining, will constitute important evidence in proof of its being a bone ash, although this fact alone supplies us with no data by which to distinguish the ash of human from that of the bones of other animals. (*Cases* 54, 55, 56.)

Cremation, as suggested by certain unpractical enthusiasts, will put an undoubted barrier, at long intervals after death, to the dead body itself furnishing evidence to assist justice (as earth burial so often permits) either in clearing the innocent or in punishing the guilty. (*Cases* 44 to 46.)

Having thus far summarized the chief points to which attention should be directed in different cases "*re identity*" we proceed to consider certain of these in detail.

I. In cases where skeletons or isolated bones have been discovered, the following questions suggest themselves :—

(1.) *Are the bones human, or are they those of some other animal?*

(2.) *If human, are they parts of the same skeleton, or do they belong to more than one body?*

(3.) *If exhumed, what length of time had the body probably been buried?*

(4.) *What evidence can be gathered from their examination as to the probable cause of the death of the person of whom they form a part?*

The following subjects will then be considered in relation to various questions respecting the identity of the living and dead :—

II. Age.
III. Sex.
IV. Stature.
V. Race.
VI. Likeness.
VII. Congenital peculiarities and hereditary diseases.
VIII. Marks of the hands and feet.
IX. Cicatrices and tattoo marks.
X. Hairs and fibres.

XI. The teeth.
XII. Stains.
XIII. Handwriting and varieties of ink.
XIV. The limits of vision.
XV. The limits of hearing.

I. Human Remains.

(1.) *Are the bones human, or are they those of some other animal?*—Bones, it may be remarked, are not necessarily human because they are found in a churchyard, or *vice versâ*. (*Cases* 40, 51, 55.) It may help us materially, however, in deciding their origin, to consider (α) their *position*, and (β) *associations*.

(α.) As regards *position*, it is customary in Christian burial to place a corpse in the ground at full length, with the head toward the west.

(β.) If with the bones be found the remains of clothes, metal buttons, jewelry, etc., such associations constitute evidence of great value in determining origin, and possibly identity. Hence the earth round about the remains in question should be carefully sifted, to see if articles that may help to establish the nature of such remains can be found. (*Cases* 41, 48, 50.)

Further, if, in addition to the body being placed east and west, other bodies arranged one above the other be found near it, such a circumstance is strongly suggestive not only that the remains are human, but that the place where they were found was at some period or another a burial-ground. In a case of this nature therefore various parts of the ground should be examined, to see whether the remains of other bodies can be discovered.

If a whole skeleton be submitted for report, no difficulty can occur in deciding whether the bones be human; for even the skulls and extremities of those anthropoid apes that somewhat resemble man in general appearance, possessing in certain cases clavicles and dental formulæ closely approximating to our own, nevertheless, as a whole, present important differences scarcely possible to overlook or confuse. But the real difficulty occurs when single bones, or fragments of bone are submitted for report. (*Cases* 40, 51.) It is not necessary for us to discuss here in any detail the points of distinction between human bones and the bones of other animals. Some of these characteristics are referred to by Dr. Taylor with questionable accuracy. No difficulty, however, can possibly arise in deciding, by the aid of the microscope, whether the smallest fragment referred for examination be bone or not, seeing that, even supposing the Haversian canals and systems

be wanting, we are certain to detect in the case of bone, at any interval of time, the presence of bone corpuscles or cells (*lacunæ*).

But in such case this is about the limit of our power. For admitting that the bones of different animals not only present differences in their chemical composition but also in their microscopical characters ("*Med. Gazette*," Dec. 11, 1845), the size of the bone-cells bearing a certain relationship to that of the blood-discs, being largest in reptiles, smallest in birds and mammals, and of an intermediate size in fish,—admitting further that the bones of the aged differ chemically from the bones of the young by containing an excess of calcareous over animal matter, and that, as a consequence, slight differences, recognizable under the microscope, may in some cases be apparent;—admitting, we say, all these facts, nevertheless, in the present state of our knowledge, they are to be regarded as mere generalizations, so broad and yet so narrow as to render them unsafe to be applied to medico-legal investigations.

If any hair be found on fragments of a skull, should such be recovered, its examination will afford important evidence. The microscopical appearance of the hairs of different animals are specially characteristic, and scarcely liable to much change either by time or burial. (*Case* 69.)

In the case of mere fragmentary particles being submitted for examination, the medical jurist should content himself with stating whether or not they are bone, venturing no opinion as to their precise origin. If, however, several bones or a more or less perfect skull be recovered, he may then be able to form an opinion whether they are human. Further than this it is not advisable to go. To state in the witness-box the precise animal of which he may believe the bones form a part, opens a door for cross-examination, which in a medico-legal case is not only, as a rule, objectless, but may do positive harm by diverting attention from the real question at issue. Opposing counsel are only too glad to seize upon such disputed points for cross-examination, in order to discredit a witness. Of course, we admit there may be cases where it is necessary to give more definite evidence, but they are not common. A door should never be opened unnecessarily, lest it be difficult to shut it when desired.

If numerous separate bones believed to be human be recovered, the question will then arise:—

(2.) *Whether they are parts of the same skeleton, or belong to more than one body?*—It is advisable in such cases to commence our investigations by examining each bone separately, to determine whether it *belongs to the right* or to the left side. This done, we should label it

accordingly, and at once place it in position. (*Case* 34.) By thus determining the side to which each bone belongs, and as we proceed fitting them together as best we can, this question may often be satisfactorily answered. Thus, if two right ulnas, or three femurs, etc., be discovered, the conclusion is obvious.

It may not be out of place to remark that, after the bones have been fitted and arranged, they should be carefully fastened together and photographed.

(3.) As regards *the length of time the bones have probably been under ground*, it is usually supposed that, in an ordinary grave, a body becomes skeletonized in about ten years. Admitting this to be substantially accurate, there are not a few cases where, on the one hand, all the soft parts have been destroyed in a far less time, and, on the other hand, where they have been preserved for a much longer period. (See *Putrefaction.*) Certain parts, such as the hair, resist decomposition almost indefinitely. After long burial, more especially in an iron-charged soil, the bones (and frequently the teeth) assume a dark or reddish-brown color.

(4.) The *probable cause of death*, judged by an examination of the bones, may be inferred if fractures and other injuries be discovered. Given a fracture of, or injury to, an exhumed bone, two questions need careful consideration: (α) Was the injury caused by violence inflicted during the life of the person, or may it have resulted from the axe or spade of the grave-digger? (*Case* 43.) And (β), if caused during life, was it of recent or of old standing? Thus in *Cases* 42, 43, and 50, fractures of the skull, indicating the cause of death, were discovered on examination.

Again, certain associations of a skeleton, such as, for example, finding the remains of a rope round the cervical vertebræ, may be suggestive of the cause of death. (*Case* 41.)

Again, a diseased condition of bone may be discovered. (*Case* 45.) In such cases much care may be necessary to distinguish between disease, decay, and violence. (*Case* 46.)

Again, if a fracture with new bone around the broken ends be found, the fact that the violence to the bone occurred during life, and even some time before death, will be abundantly proved. (*Case* 47.)

It may, further, be within the power of the medical jurist to form some opinion from the nature of the injury, as to the instrument by which the violence was inflicted (*Case* 50), and whether it was direct or indirect.

Lastly, in examining a skeleton or individual bones all such details as personal deformities, etc., should be carefully observed and [illegible]

(*Cases* 42, 44.) Further, if around and about the skeleton of a female, fœtal bones be discovered, the fact is suggestive, but by no means absolute proof, of pregnancy. (*Case* 47.)

Although from the examination of the remains of a body we may be unable to determine their identity, nevertheless we may be able to prove what, to the accused, may constitute evidence of great importance, *viz.*, that they could not have belonged to the particular body supposed.

II. Age.

Personal identity will naturally depend, in many cases, upon the age of the person concerned, or upon the age of the body or portions of the body discovered or exhumed. To determine age during life is often a matter of extreme difficulty. In the case of children we may generally fix it more or less accurately by observing the teeth, the height and weight, and the general development. It is, however, to be noted that in certain diseased conditions, such as in some cases of congenital or hereditary syphilis, a retarded puberty is not uncommon.

The middle period of life presents the greatest difficulty in determining age. Hard work, mental anxiety and dissipation may make the adult of twenty-five or thirty look forty or fifty, whilst the absence of such causes may make others look younger than their own children. Grey hairs do not necessarily denote old age, nor black hairs youth. The hair of the Albino is scarcely liable to deceive in this particular, because of its invariable association with pink eyes, but hereditary premature greyness, or the sudden influence of fright or trouble in bleaching the hair, must not be overlooked (page 177). Again, in the matter of baldness, which may be important in establishing age, much care is required. Thus cases are on record where complete baldness has been the result of fright ("*British Med. Journal*," 1879, II., p. 346), and likewise of disease (notably of syphilis) in young persons. ("*Med. Times and Gaz.*," 1870, II., pp. 518, 551, 575; "*Brit. Med. Journ.*," 1880, II., pp. 114, 157, 197, 535.)

After thirty-five, besides the "crafty crowsfeet" (of which the laureate speaks) about the eyes, other lines make their appearance in the face, more especially around the mouth. The features become more set. The eyelashes, eyebrows, and hairs of the face generally grow coarser and longer. Hair, particularly in the male sex, grows profusely in the nostrils and ears, and about the nipples. The thumbs become more pointed, and the great toe turns in a curved direction toward the middle line of the foot. The skin loses its

suppleness, and becomes either drier or more greasy. The body may either fall away ("*sinking into little room*") or grow stout. The abdomen often becomes pendulous, whilst in females the mammæ either waste or enlarge considerably. The arteries may become tortuous and cord-like, or of even bony hardness. An "*arcus senilis*" may be apparent in the eye. The figure begins to stoop, as the intervertebral substance is absorbed or shrivels; the muscular power lessens and the vertebræ become more bevelled. The teeth decay, the nose and chin approximate, and old age creeps on in the "lean and slippered pantaloons." (For a full description of these senile changes, see "*A Practical Treatise on the Diseases and Infirmities of Advanced Life,*" by Dr. Daniel Maclachlan, 1863.)

In determining age from the skeleton, or from such remains as may be forthcoming, there are several points to be noted:—

The Points of Ossification and the extent to which osseous union has progressed.—Certain details under this head may be stated as follows:—

1 *year:* Points of Ossification:—Lower extremities of humerus and ulna; heads of the femur and humerus; upper cartilage of tibia.

1½ *year:* Anterior fontanelles should be closed.

2 *years:* Points of Ossification:—Lower cartilage of radius, tibia and fibula.

2½ *years:* Points of Ossification:—Greater tuberosity of the head of the humerus; patella; lower ends of the last four metacarpal bones.

3 *years:* Points of Ossification:—The trochanters.

4 *years:* Points of Ossification:—The second and third cuneiform bones of the tarsus.

4½ *years:* Points of Ossification:—The small tuberosity of the head of the humerus; the upper cartilage of the fibula.

6 *years:* The descending ramus of the pubis meets the ascending ramus of the ischium.

From 8 *to* 10 *years:* The upper cartilage of the radius becomes ossified.

9 *years:* The ilium, ischium, and pubis meet in the cotyloid cavity (acetabulum) to form the pelvis.

10 *years:* Ossification begins in the cartilaginous end of the olecranon.

12 *years:* Points of Ossification:—The pisiform bones of the carpus.

13 *years:* The three portions of the os innominata (ilium, isch

and pubis), though nearly united, can still be separated. The neck of the femur is ossified.

14 *years, or about puberty:* There are now added some fourteen additional centres to the sacrum.

15 *years:* The coracoid process becomes united to the scapula.

Between 15 *and* 16 *years:* The olecranon becomes united to the ulna.

From 18 *to* 20 *years:* The epiphysis at the upper end of the thigh bone is joined to the body of the bone, as well as those belonging to the metacarpus, metatarsus, and phalanges.

20 *years:* The upper and lower epiphyses of the fibula, as well as the lower epiphysis of the femur, are respectively united to the bones.

25 *years:* The epiphysis of the sternal end of the clavicle, and of the crista ilii are united to the bones.

If all the epiphyses be found united to their bones, and the bones themselves are solid and well-marked as to muscles, processes, and foramina; and, further, if the jaws show the wisdom-teeth, we may conclude the individual to be of adult age.

The Vertebræ.—The epiphyses of the bodies of the vertebræ are sometimes not consolidated until 30 years of age.

The Cartilages of the Larynx in advanced life assume more the appearance of osseous than of cartilaginous structure.

The Sternum.—The second and third pieces of the sternum rarely join until the thirty-fifth or fortieth year, whilst the union of the first and second pieces is not usually complete until quite advanced life.

The Cartilages of the Ribs.—The cartilages of the ribs generally ossify late in life. Dr. Humphry regards this ossification as rather a sign of disease than of age. The first cartilage is more frequently ossified, and at an earlier period of life, in men than in women.

The Skull.—In old age the diploë is more or less absorbed, leaving the cranial bones thinner than they were in middle life. The sutures become firmly ossified, and gradually less distinct. If the sutures of the skull are indistinct, we may then fix the age as at least between fifty and sixty. As a rule the parietal sutures disappear about the age of puberty, although sometimes (but rarely) they remain separate throughout life.

The Lower Jaw.—The alveolar cavities containing the teeth are formed about the sixth month of intra-uterine life, whilst the rudiments of the whole of the temporary and some of the permanent teeth (the anterior molars for instance), are usually found within the gums in capsules at the time of birth. Again, the jaw of the infant is rounded and somewhat semicircular, the ramus and body forming

an obtuse angle. As age advances toward middle life, the jaw loses its roundness, and as the alveolar processes containing the teeth become more and more perfect, exhibits a well-marked angularity and squareness. With old age, the teeth drop out or decay away, the jaw returning to its infantile shape. After a time the whole alveolar body may become absorbed, a sharp ridge replacing the holes for the teeth as they originally existed.

The Femur.—The neck of the femur *before puberty* is directed obliquely, so as to form a gentle curve from the axis of the shaft. In the *adult* male it forms an obtuse angle with the shaft, being directed upward, inward, and a little forward. In the *female* it approaches more nearly to a right angle. Occasionally in very *old* subjects, and more especially in those greatly debilitated, its direction becomes horizontal, so that the head sinks below the level of the trochanter, and the length diminishes to such a degree that the head becomes almost continuous with the shaft.

It has previously been remarked that the bones of the aged contain a greater relative percentage of mineral to animal matter than those of the young, and that they are generally lighter from the medullary canals being larger.

Medico-legal aspects of Age. Minority and Majority.

In law, a male or female *under twenty-one years old* is regarded as an *infant* or *minor*. Before that age a male can neither alienate, by deed or by will, lands, goods, or chattels (1 Vic., cap. 26), nor can he be required to serve on a jury.

At the age of fourteen a male is supposed to have arrived at *years of discretion*, so that he can consent or refuse to marry. A female may be betrothed, or given in marriage at seven, whilst at nine she is entitled to dower (Henry III., c. 20). At twelve she is supposed to have arrived at years of maturity, so as to consent or not to the marriage contract (!). But the law requires in cases of youthful marriages the consent of the nearest of kin.

Marriages contracted by minors have, however, for manifest reasons, been held valid, although contracted against the consent of parents or guardians. At twenty-one years of age, both male and female can contract marriages and fulfil all legal and civil rights and duties, without the consent of either parents or guardians, although certain trusts may in this respect limit powers. Age, in nearly all the cases we have mentioned, must be proved by documents and not merely by medical evidence.

Full age is reckoned on the first instant of *the day before* the twenty-first anniversary of the man's birthday, *i.e.*, forty-seven hours and fifty-nine minutes short of the complete number of days, counting by hours. This mode of reckoning is applicable to all ages.

In every midwifery case it should be the rule with the medical attendant to make a note of the precise time that the child was born, remembering that the important record is not when the labor commenced, but the moment that the child was entirely expelled from the mother—in other words, the time of its legal birth. A simple note of this on the part of an accoucheur might often save a whole estate being squandered in law.

Nearly all the judges (notably Justices Earle and Keating) have held that a child up to the age of seven years, cannot distinguish right from wrong, so as to be *capable of crime*. If, however, "*a malicious intent*" can be proved, in other words, a guilty knowledge of the nature of the act, the law supposes that *malitia supplet ætatem*. If a child under fourteen be indicted for murder or arson, it must be shown that the child is conscious of the nature of the act. In the case of *R.* v. *Vamplew* (Lincoln Summer Assizes, 1862), a girl under fourteen years of age was convicted of poisoning by strychnia.

"In all cases, the question is, whether the jury are satisfied that the child, of whatever age, has sufficient knowledge and discretion to understand that he is doing a criminal act, for if he has, he is answerable to the law for the consequences, and whatever the feelings of courts and juries may be on such occasions, it would be highly detrimental to the public if any age was exempt, because people of full years would employ children to commit crimes of almost every description."

Under fourteen a male infant is not supposed to be capable of committing a rape, nor even a criminal assault in the first degree, although he may be convicted as a principal in the second degree. Under ten years of age, a female is presumed to be incapable of consenting to sexual intercourse. Hence in cases of rape, provided the girl be less than ten years of age, the question of consent or non-consent is immaterial, nor indeed is the case altered even by solicitation on her part. Under such circumstances a rape is felony. (24 & 25 Vic., c. 100, sec. 50.)

If a rape with consent be committed on a girl between the ages of ten and twelve, the crime is regarded as a misdemeanor (24 & 25 Vict., c. 100, sec. 51), whilst if she be above twelve, intercourse with consent ceases to be illegal.

In the case of unnatural crimes, both the active and the passive

agent are deemed equally guilty, but if the passive agent be a boy under fourteen or a girl under twelve, the active agent only is charged.

III. Sex.

(This will be discussed in detail in a following chapter.)

IV. Stature. (*Height and Weight.*)

The following are the average lengths of the fœtus at different periods of intra-uterine life, and also of children and adults at various ages. The Table is taken from M. Sue (*Mémoires de l'Academie Royale des Sciences*, 1755, Tom. II., p. 574):—

Age.	Total length.	Trunk.	Upper Extremities.	Lower Extremities.
Fœtus of 6 weeks	16 lines.	1 inch.	5 lines.	4 lines.
2½ months.....	2 inches 3 lines.	1 in. 8 lines.	9 "	7 "
3 "	3 inches.	2 " 1 line.	13 "	11 "
4 "	4 inches 4½ lines.	2 " 11 lines.	1 in. 9 lines.	1 in. 5½ lines.
5 "	6½ inches.	4 " 4 "	2 " 6 "	2 " 2 "
6 "	9 "	5 " 8 "	3 " 7 "	3 " 4 "
7 "	1 foot some lines.	6 " 5½ "	5 " 10 "	5 " 9 "
8 "	14 inches 9 lines.	8 " 3½ "	6 " 8 "	6 " 6 "
9 "	18 inches.	10 inches.	8 inches.	8 inches.
Age 1 year	22½ "	13 in. 6 lines.	9 "	9 "
" 3 years....	2 ft. 9 in. some lin.	19 inches.	14 "	14 in. some lin.
" 10 "	3 feet 8½ inches.	2 feet.	19 "	20 in. 6 lines.
" 14 "	4 " 7 "	2 feet 4 in.	24 in. 6 lines.	27 inches.
" 25 "	5 " 4 "	2 " 8 "	30 inches.	32 "

Six pounds eight ounces is about the average weight of English children at birth; girls, as a rule, weighing a trifle less, and boys a trifle more. For the first twelve years of life the children of both sexes progress in weight as nearly as possible alike year by year.

The following Table gives the average monthly weights of young children during the first year:—

	lbs.	oz.		lbs.	oz.
At birth	6	8	7 months	13	4
1 month...........	7	4	8 "	14	4
2 months	8	4	9 "	15	8
3 "	9	6	10 "	16	8
4 "	10	8	11 "	17	8
5 "	11	8	12 "	18	8
6 "	12	4			

It would appear that the average weight and length of Indian children are less than those of European. The following details are given on the authority of Dr. Harvey ("*Indian Med. Gaz.*," July 1, 1876, p. 172).

MALE CHILDREN (53 observations).

	lbs.	oz.		inches
Average weight......	5	8	Average length.......	18.5
Maximum "	8	12	Maximum "	23.0
Minimum "	3	3	Minimum "	14.5

FEMALE CHILDREN (63 observations).

	lbs.	oz.		inches.
Average weight......	5	8	Average length.......	17.4
Maximum "	7	3	Maximum "	23.0
Minimum "	3	3	Minimum "	12.0

Ingerslev (Assistant at the Lying-in Institution of Copenhagen), who has weighed a large number of children, states that at full term, boys weigh on an average 110 grammes (about 3¾ ounces) more than females. His researches do not confirm the conclusion arrived at by Dr. Matthews Duncan, that the maximum weight is to be found in those born at full time between the twenty-fifth and twenty-ninth years of the mother's age.

Bouchut ("*Gazette des Hopitaux*," July 7, 1874) gives 3 to 4 kilos. (6.6 to 8.8 lbs.) as the ordinary weight of the infant at birth, the extremes being 1½ kilos. (3.3 lbs.) and 7 kilos. (15.4 lbs.). The weight of children at birth is influenced by the height and constitution of the parents, and particularly by the accidents of pregnancy. Scrofula and syphilis in either parent, frequent vomitings or excessive hemorrhages on the part of the mother during pregnancy, cause a diminution in the weight of the offspring.

In most cases a considerable diminution in the weight of the child occurs shortly after birth. This rule in healthy children, born of healthy mothers, is almost universal. Occasionally the weight will remain stationary, and even increase slightly during the first day, either because the meconium is not evacuated within the first twenty-four hours, or was evacuated during labor and before the child was weighed. In such case the diminution in weight will commence about the second or third day. This decrease may be taken to be

from 30 to 100 grammes (roughly from 1 to 4 ozs.) during the first day, the total decrease being about the one-fourteenth of the child's weight at birth. The loss of weight is greatest in first-borns and in boys, although in boys it is more rapidly recovered than in girls. Again, the loss is greatest and the increase more tardy, in inverse proportion to the development of the infant. As regards the after increase, it may be taken that in sixty per cent. children begin to increase in weight about the fourth day, and that on the tenth day the weight will be the same, or even slightly greater than at birth. In some cases, however, a considerably longer period elapses before the birth-weight is reached.

To what is this loss of weight to be attributed? The evacuation of the urine and meconium and the pulmonary and cutaneous transpiration, will at most not explain more than fifty per cent. of the decrease. Neither will an insufficiency of food, due either to the mother having too little milk or to the child being unable to take it, account for it, as experiments abundantly prove. Facts, however, seem to show that the loss depends on the child being unable to derive benefit from the food it takes, the stomach and intestines during the first few days wanting in assimilating power. Thus loss of weight is to be expected during the first few days of life, although the food given may have been abundant in quantity and proper in quality. (Chaussier, Siebold, Haake, Winckel, Gregory, Kezmarsky, Boucharp, Ritter, Ingerslev. See "*London Med. Rev.*," Oct. 15, 1875, p. 594; *Bouchut* "*Gazette des Hopitaux*," July 7, 1874.)

The increase in a child's weight after the primary decrease should be progressive. During the first five months, 20 to 30 grammes per day (= 308 to 462 grains) or say 175 grammes per week, and during the succeeding seven months 10 to 15 grammes per day may be regarded as proof that the child is thriving. At five months, therefore, the child should weigh twice as much as it did at birth, and at sixteen months double what it did at five months. Bouchard considers that a child should imbibe 630 grammes of milk per day during the first month, 700 during the second, 840 during the third, and 950 during the fourth. (See "*Medical Times and Gazette*," July 18, 1874, p. 81.)

It is certain that, as a child grows up, its stature will depend on the air it has to breathe, the food it has to eat, and the work to which it is subjected. Dr. Bridges' tables, showing the deterioration in the height and weight of factory children, are interesting:—

TABLE I.—HEIGHT.

Age.	Factory Children of factory Parents.		Children in non-factory districts.	Non-factory Children of non-factory Parents in factory districts.
		Inches.	Inches.	Inches.
8	Male	45.75	46.66	46.72
	Female	46.48	46.73	47.40
9	Male	48.05	49.21	49.09
	Female	47.62	48.63	49.37
10	Male	46.77	51.00	51.02
	Female	49.52	50.07	49.76
11	Male	51.44	52.87	52.57
	Female	50.80	53.66	52.80
12	Male	52.82	54.05	53.56
	Female	53.13	54.41	53.39

TABLE II.—WEIGHT.

Age.	Factory Children of factory Parents.		Children in non-factory districts.	Non-factory Children of non-factory Parents in factory districts.
		Pounds.	Pounds.	Pounds.
8	Male	55.60	55.08	53.15
	Female	50.73	52.82	53.64
9	Male	58.41	60.02	59.40
	Female	54.63	56.53	57.79
10	Male	62.14	65.29	63.76
	Female	59.75	61.19	60.78
11	Male	67.22	71.01	70.22
	Female	63.94	68.00	68.97
12	Male	70.74	75.00	70.94
	Female	71.46	75.95	70.55

Here we remark that the factory boys of factory parents, are, on an average, at eight years old nearly 1 inch shorter than those of either of the other classes, whilst at twelve the boys of non-factory districts have gained another ½ inch in height over factory boys. The same results appear in the case of the girls, although in a lesser degree. As to weight, although the factory boys start ahead of both the other classes, nevertheless at twelve years old those of non-factory districts exceed the others by some 5 pounds; whilst at the same age

the girls, who start considerably ahead, are nearly 3½ pounds less when compared with non-factory girls.

As regards adults, the average weight of males at twenty is 143 lbs., and of females 120 lbs. Women, however, as a rule increase in weight yearly up to fifty, but males only up to thirty-five. In advanced age, both sexes weigh about fifteen times their weight at birth.

The subjoined figures are reduced from the French weights and measures given in Quetelet's "Anthropométrie" (Brussels, 1870). They are the averages of a large number of observations on Belgians, and are probably a little under the mark as regards the English.

MALES.			FEMALES.		
Age in Years.	Height in Inches.	Weight in Pounds.	Age in Years.	Height in Inches.	Weight in Pounds.
Birth.	19.7	6.8	Birth.	19.3	6.6
1	27.5	19.8	1	27.0	18.9
2	31.0	24.2	2	30.7	24.2
3	34.2	27.5	3	33.6	27.2
4	36.6	30.8	4	35.9	30.5
5	38.8	34.9	5	38.5	33.6
6	41.2	39.1	6	40.7	36.7
7	43.4	43.3	7	42.9	39.1
8	45.7	47.5	8	45.5	41.8
9	48.1	51.7	9	47.4	46.2
10	50.4	55.4	10	49.2	50.8
11	52.5	59.4	11	50.6	56.1
12	54.5	63.8	12	52.7	63.8
13	56.4	72.8	13	55.8	71.5
14	58.6	81.6	14	58.1	79.8
15	61.0	90.6	15	58.9	88.0
16	63.0	99.8	16	59.8	95.7
17	64.6	109.3	17	61.1	102.9
18	65.2	118.5	18	61.6	109.5
19	65.6	126.7	19	61.8	114.6
20	65.8	130.9	20	62.0	117.0
21	*65.5	134.6	21	62.1	[illegible]
22	*66.2	138.3	22	—	[illegible]
23	*66.2	141.9	23	—	[illegible]
24	*65.9	—	24	—	—
25	*66.3	145.6	25	—	120.5
27	*66.4	144.9	27	—	121.2
30	66.3	145.4	30	—	121.6

* The heights with asterisks are from Danson.

The subjoined table of measurements is taken from Barthes and Rilliet's well-known book on the diseases of infants. It is founded on the measurements of thirty-seven well-nourished and well-grown children:—

	3½ to 5 Years.	6 to 10 Years.	11 to 15 Years.
	Inches.	Inches.	Inches.
Height	32.8 to 38	38 to 50.8	50 to 52.8
Length of Sternum	4.4 to 5.2	4.8 to 6	5 to 7.2
Length of *Dorsal Vertebræ*	5.6 to 8.8	7.2 to 10.4	9.2 to 11.6
Space between the Coracoid processes	5.2 to 6.8	6 to 8	7.6 to 10.8
Round the Thorax (under Armpits) during inspiration whilst seated	20.4 to 24.4	22.4 to 26.8	27.6 to 35.2
Round the Thorax (under Nipples) during inspiration	22 to 25	22.4 to 26.8	27.2 to 32

Dr. Guy gives the following table of averages from the measurements of forty-four male and seven female subjects. They are expressed in inches and parts of an inch.

Sex.	Stature.	Vertex to Pubes.	Pubes to Foot.	Upper Extremity from Acromion.	Femur.	Tibia.	Fibula.	Humerus.	Radius.	Ulna.
Male	66.5	33.5	33.0	29.5	17.66	14.58	14.16	12.4	9.4	10.16
Female	61.0	31.1	29.0	26.66	16.5	13.75	13.4	11.6	8.66	9.75

Some additional proportions are given by M. de S. Luca ("*Cosmos*," October 2, 1863, p. 386). He takes the average height for the adult French male to be 63 inches, or 160 centimetres, and for the adult French woman, $\frac{1}{20}$th less, or about 5 feet. In England it may be taken that the average height of males brought up under favorable circumstances is 5 feet 9¾ inches, and of females 5 feet 2 inches. The head is ⅛th part of the total height, and is divided into two equal parts immediately below the eyes, the nostrils being midway between the eyes and chin. In a vertical section of the body the pubis is a central point between the two extremities. When the arms are raised vertically above the head, the navel becomes the centre of the length. If the arm be divided into five parts, the hand occupies one part and the forearm and arm two parts each. Multiplying therefore the length of the hand by five we get the length of the arm. The carpal and metacarpal bones represent half the length of the hand. The first phalanx of the middle finger occupies one-fourth of the entire hand, its last two phalanges being together equal to the length of the first. The last phalanx is just halved by the nail. The sole of the foot is one-third

longer than the palm of the hand, but the back of the foot, or instep, is as nearly as possible the same length.

It may not be out of place to note here that (according to Dr. Sieveking) the *weight* should be in the following proportion to the height:—

Model Heights and Weights.

The Height being	The Weight should be
5 feet 1 inch.	8 stone 4 lbs.
5 " 2 "	9 " 0 "
5 " 3 "	9 " 7 "
5 " 4 "	9 " 13 "
5 " 5 "	10 " 2 "
5 " 6 "	10 " 5 "
5 " 7 "	10 " 8 "
5 " 8 "	11 " 1 "
5 " 9 "	11 " 8 "
5 " 10 "	12 " 1 "
5 " 11 "	12 " 6 "
6 " 0 "	12 " 10 "

We now pass from the measurements of the living to the measurements of the skeleton at various ages. And here we must note particularly the relationship between the total height of the skeleton and the length of the several bones of which the skeleton is composed. For the proposition submitted to the medical jurist is usually as follows:—Given, the length of one or two bones, or of an entire limb, determine the probable height of the skeleton and of the living body. (*Cases* 34, 49.) Dr. Humphry's tables are as follows:—

Measurements at different Ages (in inches).

Age.	Height.	Spine.	Circumference of Skull.	Humerus.	Radius.	Hand.	Femur.	Tibia.	Foot.	Pelvis. Transverse Diameter of.	Pelvis. Antero-posterior.
At birth	19	7.0	15.0	3.5	2.5	3.1	4.3	3.5	3.5	1.3	1.3
2 years (average)	27	8.5	17.7	4.7	3.6	3.1	6.2	5.1	3.6	2.2	2.2
4 to 6 years (average)	35	11.8	18.0	6.6	4.8	4.1	9.1	7.1	5.1	2.5	2.5
8 to 12 years (average)	43	12.8	18.8	8.3	6.0	5.1	11.4	9.4	6.4	3.1	3.1
15 yrs. Female	55	17.0	19.0	10.3	7.0	5.8	14.8	11.0	7.8	4.0	3.6
15 yrs. Male	54	16.5	19.0	10.5	7.5	5.6	15.0	11.5	—	—	—
15 yrs. Average	54	16.6	19.3	10.4	7.4	5.7	14.8	11.6	8.0	3.8	3.6
18 to 19 yrs. Female	59	19.0	19.5	11.0	8.2	6.5	16.0	12.8	8.0	5.0	4.8
18 to 19 yrs. Male	59	17.5	20.4	11.0	8.5	6.3	15.0	13.0	8.0	3.9	3.8
18 to 19 yrs. Average	60	18.5	19.8	11.4	8.6	6.6	15.8	13.3	8.3	4.7	4.5

Average measurement at different Ages, reduced to a Scale of **100.**

Age.	Height.	Spine.	Circumference of Skull.	Humerus.	Radius.	Hand.	Femur.	Tibia.	Foot.	Pelvis. Transverse Diameter of.	Pelvis. Antero-posterior.
Birth	100.00	36.84	79.00	18.50	13.20	16.30	22.60	18.50	18.50	6.80	6.80
2 years	100.00	31 48	65.55	17.40	13.33	11.48	22.94	18.88	13.33	8.14	8.14
4 to 6 years	100.00	33.71	51.42	18.85	13.71	11.71	26.00	20.28	14.57	7.14	7.14
8 to 12 years	100.00	29.76	43.72	19.30	14.09	11.86	26.51	21.86	14.65	7.21	7.21
15 years	100.00	30.74	35.70	19.25	13 70	10.55	27.40	21.48	14.81	7.03	6.66
18 to 19 years	100.00	30.83	33.00	19.00	14.33	11.11	26.33	22.16	13.83	7.83	7.50
Adult	100.00	34.15	31.54	19.54	14.15	11.23	27.51	22.15	16.03	8.00	6.61

Orfila's measurements show in many respects remarkable differences to those given by Dr. Humphry. They are, however, often quoted, and we reproduce both his tables, chiefly for the purpose of showing that the medical jurist must not be too dogmatic on the relative length of bones.

TABLE I.—(Orfila's first Table.)

Stature calculated from length of bones.

[The measurements are given in inches and fractions of an inch.]

Length of Bone.		Stature.		
	Inches.	Maximum.	Minimum.	Difference.
Humerus (19 obs.)	14.50	68.10	64.50	3.60
Ulna 14 "	10.66	70.80	65.66	5.14
Femur 12 "	17.75	69.66	64.50	5.16
Tibia 11 "	14.21	69.66	64.50	5.16

TABLE II.—(Orfila's second Table.)

Stature calculated from length of bones.

Length of Bone.		Stature.		
	Inches.	Maximum.	Minimum.	Difference.
Humerus (6 obs.)	13.00	73.25	69.75	3.50
Ulna 7 "	10.66	73.25	65.00	8.25
Femur 7 "	18.10	72.00	67.00	5.00
Tibia 7 "	15.00	70.50	65.00	5.50

Given then that we have determined from a bone the probable length of the skeleton, the question arises, *Can we form an opinion as to the probable height of the person when alive?* On this we shall only say that in such calculations it is usual to add from 1.0 to 1.5 inch for the soft parts. But this at best is merely an approximate estimate, and we must be careful in evidence to explain exactly on what principle we have formed our opinion, and not state it as though it were capable of indisputable scientific proof.

V. Race.

It is in the skull where the chief differences of race are manifest. We cannot do more than briefly indicate the characters of the three classes:—

I. *The prognathous skull of the Negro.*—In this form of skull there is a peculiar forward extension or prolongation of the jaw. The foramen magnum is placed far back. The organs of sense (smell and hearing), are usually highly developed.

II. *The pyramidal skull of the Esquimaux, and of the inhabitants of North and Central Asia.*—In this form of skull there is a peculiar lateral or outward projection of the zygoma, due to the form of the malar bones, rendering the skull lozenge-shaped in appearance.

III. *The oval or elliptical skull of the Indo-European or Caucasian.*—This is essentially symmetrical, with no marked prominences, and no undue compressions.

In the museum of the London Hospital, there are skulls of different races, which might easily, both for size and capacity, be taken to be European. Hence extreme caution must be exercised in drawing conclusions as to race from the shape of the skull. The degradation and the elevation of a race or of individuals play no unimportant parts in determining shape.

Cloquet, Cruvelhier, and some other anatomists have stated that the capacity of the skull is about the same in different races. Tiedemann, Ward, and later writers have, after careful experiment, come to a different conclusion. Ward gives the following table:—

		Weight of Skull without Lower Jaw. oz. avoir.	Weight of Millet Seeds the Skull will hold. oz. avoir.
French	1	26.00	42.50
	2	20.60	31.50
Chinese	1	34.50	37.25
	2	27.00	39.25
Scythian	1	40.25	34.00
	2	32.00	35.75

In the negro the feet are very wide apart and flat, whilst the os calcis is remarkable for its backward projection. The skin of a negro,

and that of other dark races, is peculiar both in the great depth of its color and in the thickness of the rete mucosum. The hair is also well known to be modified by race.

The measurements of *skeletons of different races* must be noted. On this we quote Dr. Humphry's tables:—

Measurements of Human Skeletons of different races, etc. (in inches).

	Height.	Middle point of Skeleton.	Length of Spine.	Circumference of Skull.	Humerus.	Radius.	Hand.	Femur.	Tibia.	Foot.	Pelvis. Transverse Diameter of.	Pelvis. Antero-posterior Diameter of.
European (average of 25)..	65	Symphysis Pubis.	22.2	20.5	12.7	9.2	7.3	17.88	14.4	10.60	5.2	4.3
Negro (average of 25).......	62	1 inch below Symphysis	19.3	19.8	12.1	9.4	7.7	17.00	14.4	11.11	4.6	4.1
Bosjesman (average of 3)...	54	Symphysis	17.0	19.6	10.8	8.3	6.0	15.00	12.9	7.50	4.4	3.5
Idiot (in Berlin Museum) ...	57	Symphysis	19.5	13.5	12.0	8.8	7.0	16.00	12.5	8.50	5.0	3.8

The same, reduced to a scale of 100.

	Height.	Length of Spine.	Circumference of Skull.	Humerus.	Radius.	Hand.	Femur.	Tibia.	Foot.	Pelvis. Transverse Diameter of.	Pelvis. Antero-posterior Diameter of.
European.......	100.00	34.15	31.54	19.54	14.15	11.23	27.51	22.15	16.03	8.00	6.61
Negro..........	100.00	31.13	31.94	19.52	15.16	12.42	27.40	23.23	17.90	7.42	6.61
Bosjesman......	100.00	31.48	36.29	20.00	15.37	11.11	27.78	23.89	13.78	8.15	6.48
Idiot...........	100.00	34.21	23.68	21.05	13.43	12.28	28.07	21.92	14.96	8.94	6.66
O'Byrne at 8 ft. 2 inches........	100.00	30.61	23.98	17.35	13.26	10.41	24.69	21.43	12.75	6.94	6.33
Irish Giant, 8 ft. 6 inches........	100.00	33.04	33.83	16.86	13.23	10.10	24.70	20.90	11.57	8.33	4.45
Sicilian female at 10 yrs., 20 inch's	100.00	31.00	70.00	17.50	13.00	11.00	25.00	17.50	14.00	7.00	7.50
Bébé (or N. Perry) at 23, 3 feet...	100.00	—	—	22.23	13.60	—	26.39	19.45	—	8.63	6.67

VI. Likeness.

Questions of likeness may arise in cases of bastardy, and in discussions respecting claimants to titles or property, etc. In such inquiries medical evidence is not, as a rule, required. Nevertheless, the

subject is one which, in many respects, calls for the special consideration of the medical jurist.

The author knows a case where a young lady who had an illegitimate child accused a person in a high position of life of being the father. This the accused denied. When the child, however, was nine or ten years old, the extraordinary likeness the child presented to the person in question (a man of exceptionably remarkable appearance) proved, beyond doubt, who had told the truth.

It has generally been held that the *male* parent transmits the characters of the skeleton, the conformation of the limbs, brain, and senses, whilst the *female* parent transmits the constitution, the internal organs, and the sympathetic nervous system. This may be mainly true, but the exceptions are so numerous that the rule is useless from a medico-legal point of view.

Lord Mansfield said, "I have always considered likeness as an argument of a child being the son of a parent." The decision in the Douglas Peerage case, in the summing up of which the above remark was made, was chiefly based on the circumstance that the claimant (Archibald) was in features, gestures, and habits, like the father (Sir John Douglas), and his twin-brother (Sholto) like the mother (Lady Douglas). In the famous Tichborne case, there was strong evidence that the claimant was like the father of Arthur Orton in features, voice, and figure. (*Case* 4.)

The true difficulty in such cases appears to be to gauge the exact value to be attached to evidence of this nature, the power of seeing likenesses being essentially peculiar.

However valuable evidence of likeness may be in proof of relationship, it is certain that the absence of likeness affords no evidence of non-relationship. (*Cases* 8, 10, 19, etc.)

In considering questions of likeness, there are three points specially deserving attention:—

(*a.*) That likeness, appearance, expression, etc., may be greatly altered by fatigue and hardships.[1]

(*β.*) That in considering identity, certain peculiarities, besides mere

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[1] "Danger, long travel, want, and woe
Soon change the form that best we know;
For deadly fear can time outgo,
And blanch at once the hair:
Hard toil can roughen form and face,
And want can quench the eye's bright grace,
Nor does old age a wrinkle trace
More deeply than despair."—Sir Walter Scott.

likeness, such as tricks of manner, modes of speech, left-handedness, handwriting, etc., demand special consideration. At the same time it is to be remembered (1) that children are essentially copyists, and copyists frequently of other than blood relatives, and (2) that peculiarities occasionally skip generations (atavism.)

(γ.) Criminals are often great adepts at personal disguisement. Thus we are told that the famous Blackheath burglar (Charles Peace), who was tried and executed for the murder of Mr. Dyson (1879), had so remarkable a power of changing his features and altering his expression that he was accustomed to face detectives who not only knew him well, but were actually seeking to arrest him at the time he was talking to them, and was moreover able to deceive his own wife and son as to his identity.

Passing from the identity of the living person to that of the dead body before putrefaction sets in, it is important to note that remarkable changes in the features take place, in many cases, within a very short time of death. (*Case* 29.)

We have already mentioned the fact that post-mortem changes may produce effects, which in the matter of likeness may serve to deceive those who knew the person well when alive.

VII. Congenital Peculiarities.—Hereditary Diseases.

These may often constitute the strongest possible evidence in proof or disproof of identity. Thus *moles* are sometimes transmitted through several generations. *Nævi materni* or *mother's marks*, are far more common than is generally supposed. (*Cases* 5, 10, 28, 29.)

It may be worth noting that nævi in newly born children, more especially when on the face and neck, may closely simulate marks of violence. (See "*Med. Gaz.*," Vol. XXXIX., p. 379, and Vol. XXXVII., p. 530.)

Polydactylism [2 Sam. xxi. 20; and 1 Chron. xx. 6], hypospadias, etc., are peculiarities frequently transmitted through many generations.

The rare circumstance of one iris having a different tint to the other, proved of importance in one case of doubtful identity. Such deformities, it may be worth noting, as hare-lip, cleft palate, etc., may not at first be detected where an operation has been successfully performed, and a luxuriant beard and moustache cultivated.

The existence of hereditary diseases may constitute evidence of

some value in cases of identity. (*Case* 3.) Of these gout, phthisis, and syphilis, may be specially mentioned.[1]

VIII. Marks of the Hands and Feet.

Although footprints and the marks of boots and shoes are generally matters of police investigation, yet occasionally questions relating to them are referred to the medical jurist. This will be especially the case where anatomical peculiarities in the conformation of the feet or hands occur.

And here an important question presents itself, *viz.*, *what is the relation in size between footprints and the feet that produced them?* Some have contended that the impress made by a foot *always* corresponds in size with the foot. Others, as Mascar of Belgium and Caussé are of a different opinion, Mascar contending that the footprint is generally *smaller*, and Caussé that it is generally *larger* than the foot.

In comparing footprints it is to be noted that we may have to compare:

(1.) Footprints with the naked foot: or,

(2.) Footprints of a shooed foot with the boot worn at the time the footprint was made: or,

(3.) Footprints of a shooed foot with a boot belonging to the same person, but not the identical boot worn at the time.

It is certain that the evidence in this third case must be always unsatisfactory, the shape and size of different boots belonging to the same person varying greatly.

The author, as the result of numerous experiments, notes that footprints may be both larger and smaller than the boot or foot which produced them, the exact relationship in size being dependent on several causes:—

(1.) *The material on which the footprint occurs.* Thus in the case of an impress occurring in sand or in any material composed of minute, freely movable particles, the footprint is usually smaller than the foot. In the case of *dry* sand, for instance, this is due to disturbed particles at the edge of the impress gradually falling in and filling up

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[1] "See what thy guilty love has done,
Repaid thee with too like a son."—BYRON.

"Fortes creantur fortibus et bonis:
Est in juvencis, est in equis patrum
Virtus: nec imbellem feroces,
Progenerant aquilæ columbam."—HORACE.

the cavity as the boot is being withdrawn. In the case of *moist* sand, an alteration in the size of the impress occurs so rapidly that it is scarcely possible, from the marks, to form an opinion of any value at all. It always appears, however, as a matter of fact, that in such case, the impress is of *less* size than the foot.

Again, if the impression be made in *clay* or other material not composed of fine and free particles, the impress is invariably larger than the foot. And this appears to be due to the circumstance that in walking the foot is invariably lifted from the ground in the opposite direction to that in which it was placed upon it.

(2.) *The impress will depend on the shape of the boot or shoe worn.*—A boot having a sole with a bevelled edge produces a very different impress to one where the edges of the sole slope outward: the former having a tendency to make the footprint smaller, and the latter larger than the boot. It will be evident from this (α) that if the boot worn be in any respect peculiar as regards shape or size, and the impress corresponds thereto, or if the impress indicates certain nails corresponding to those present in the boot, such evidence is important and satisfactory. But (β) that if a boot which is not the one worn at the time the impress was made be compared with a footprint, its correspondence is no positive evidence of identity, nor its non-correspondence of non-identity.

(3.) *The size of the impress will depend on the rapidity of progression.*—The impress for instance produced by the foot (naked or shooed) of a person running, is always smaller than that of the same person walking. And further, the impress of the foot of the same person standing, will be larger than either. The reason of this is manifest, viz.: that the size of the impress depends greatly on *the depth* of the impress, and the foot being less time in contact with the ground in running than in walking, produces a *less deep* and therefore a *smaller* impress.

(4.) *The extent of the impress will depend on the rapidity of progression and on the level of the ground.*—In a slow walk the impress more or less of the whole foot will probably be marked, whilst in running the mark of the heel will be less distinct, and that of the front of the foot more distinct, than in walking. Further, in going up hill there may only be slight evidence of the mark of the heel, although the mark of the ball of the foot may be very distinct; whilst in coming down hill, the impress of the whole foot, but especially of the heel, will generally be well defined.

(5.) *The character, shape, and size of the impress will depend to a large extent on peculiarities of gait.*—And these peculiarities in com-

paring footprints should be most carefully noted, constituting as they do, important evidence. Thus some people, so soon as they put their foot on the ground, move it slightly to one side or the other, thereby increasing the size of the whole impress; others move the heel only; others the front part of the foot and not the heel. The author has seen a case where from a peculiarity in moving the heel so soon as the foot was placed on the ground, there could scarcely be a possibility of mistaking a certain person's footprints amongst any number of other footprints.

(6.) Marks of blood may be found on the floor of an apartment, which it may be necessary to compare either with the naked foot of an accused, or with the boot he is supposed to have worn at the time. If a blood stain be found on the sole of a boot belonging to and worn by a prisoner, and corresponding marks be found on a floor, the evidence is important; but in the case of a naked foot, supposing the blood to have been washed off, and there be no peculiarities in the conformation of the foot and toes corresponding to the stain, the evidence of a blood impress on a floor can in itself be of very little value *re identity*.

(7.) The surroundings of all footprints should be carefully investigated. Thus in *Case* 11 certain blood stains found *on the left side of the footprints* constituted most important evidence in proving identity. Hence, in all such cases, the direction of stains, position of weapons, etc., compared with the footprints, should be recorded.

It may be necessary in some cases to take a cast of certain footprints to produce in evidence. As a rule such casts are difficult to take, and frequently not so satisfactory as one could wish. When the impressions occur in sand or in soft mud, M. Hougolin suggests first warming the marks by holding a live charcoal pan or hot iron over and near them, and then filling up the cavity thus heated, with powdered stearic acid (suggested by Sonnenschein), or with paraffin. A hot iron should then again be passed over the impress (taking care to be well outside the marks), then more paraffin put in, and the hot iron again applied. When cool, the paraffin may be removed, and a plaster cast taken from it.

I have frequently succeeded in taking plaster casts direct from sand, mud, etc., but where a single footstep is all that exists, and the experiment therefore impossible to repeat, the former plan is preferable, as being the more certain of success if carefully performed.

In the case of blood stains on a floor, etc., it is better for purposes of evidence to remove intact the stained piece of board. If the blood stain cannot, however, be completely removed in this way, it should be carefully moistened by means of a soft broad brush, with a mixture of

glycerine and water (1 to 10 of water), and an impression of the stains taken on thick unsized paper of rather rough texture.

Rules to be observed and questions considered in the examination of footprints, etc.

(1.) Note any special peculiarities in the conformation of the foot (*e.g.*, bunions, etc.).
(2.) Note any special peculiarities in the boots supposed to have been worn when the impressions were made (*e.g.*, unusual pieces of iron, nails, and any parts of the soles or heels worn away, indicating peculiarities of tread, etc.).
(3.) *Question.*—Do the impressions appear to correspond with the boots said to have been worn? (Be careful not to be misled by comparing a right-handed boot with a left-handed impress, or *vice versâ*. Specially compare all peculiarities.)
(4.) Note—
 (α.) *The material on which the impressions occur* (*e.g.*, sand clay, etc.).
 (β.) *The exact shape of the impressions.* Is the heel well marked or not? Endeavor from this to draw some conclusion as to whether the person was standing, walking, or running. Note any signs in the footprints indicating peculiarities of gait.
 (γ.) *The level of the ground on which the impressions occur.*
(5.) If there be any marks of blood on the ground, do they correspond or not to marks found on the soles of the boots?
(6.) Take (if possible) casts of the impressions for evidence. Preserve the blood stains, or take impressions of them on paper.
(7.) Note all the surrounding of the footprints (such as stains, weapons, etc.,) and their position in relation to the footprints.

IX. Cicatrices (Scars) and Tattoo Marks.

(A.) Cicatrices.

A cicatrix results from a layer of white fibrous or connective tissue (known as cicatricial tissue) being formed between the cut, torn, or otherwise severed surfaces of a wound. The tissue of an old cicatrix becomes in the course of time very dense, but it is never converted

into true skin. It contains neither sebaceous follicles, adipose cells, nor hairs, and but few absorbents, blood-vessels, or nerves. Further, it never acquires a "rete mucosum," and hence contains no pigment cells. (*Dupuytren* and *Delpech.*) A scar on a negro is, therefore, more or less colorless, and, as a rule, very apparent by contrast with the dark-colored skin.

The poor supply of blood-vessels to cicatricial tissue explains why the marks of a cicatrix may often be rendered more distinct, and even visible when almost faded, by first of all compressing the skin firmly (preferably as Foderé suggests with a cold pewter plate), and suddenly removing the pressure. The blood then rushes into the sound skin, leaving the tissue of the scar, into which it does not enter, conspicuously white by contrast with the surrounding redness. A similar result may be obtained by vigorously slapping the part where a cicatrix exists, or by rubbing it briskly with the hand, when the whiteness of the scar is rendered conspicuous by the slight redness induced in the sound skin.—(See paper on "The Structure of Cicatrices," by Mr. Henry Gray, "*Trans. of the Path. Soc.*," II., p. 289.)

The presence or absence of scars frequently constitutes important evidence in medico-legal cases. (*Cases* 1 to 5*a*, 16 to 19.)

If scars be present, their probable cause and the length of time they have existed—in other words, the period that has elapsed since the wounds which caused them were inflicted—will be questions asked of the medical jurist.

If they be not present, the question may then arise whether they can, and how they may, be removed artificially, or whether they may disappear naturally.

In deciding questions of identity from the presence of scars, the possibility of fraud must always be borne in mind. Moreover, it is possible for two people to have similar cicatriçes. (See *Case* 16.) Thus, in 1794, a case occurred in France, where a man named Lesurgues was executed for a murder, the proof of his identity depending for the most part on certain scars on the hand and forehead. His innocence was afterward established, the real man who confessed to the murder being found to have similar cicatrices to the man executed. For these reasons the medical jurist must note with the minutest precision, the situation, color, shape (design), and exact nature of all scars submitted to him for report.

The following questions must be considered:—

1. Does a wound necessarily leave a cicatrix?
2. How far can the *period at which a wound was inflicted* be inferred from the *appearance* of a cicatrix?

3. How far can the *nature of a wound* be inferred from the *character* of the cicatrix?
4. How far can *the extent of a wound* be inferred from the *size* of the cicatrix?
5. Can a cicatrix be obliterated either by time or by artificial means?

1. *Does a wound necessarily leave a cicatrix?*

A scar inevitably results from a wound involving loss of substance.

Further, it must be remembered that scars are more distinct in the dark than in the fair, and when they occur over a blue vein than in the white flesh.

No scars may result from slight punctures, where the surface of the skin only has been pierced, such as by the prick of a lancet, or the bite of a leech. Again, the scar arising from a perfectly clean cut with a sharp instrument (more particularly if in the direction of the muscular fibres), the surfaces being immediately afterward brought into contact, may be so slight, narrow, and uniform (often nothing more than a fine white line) as to escape notice even on close examination.

If then on examining a part alleged to have been recently wounded, we are unable to find any signs of a cicatrix, we should be justified in stating that the probabilities are altogether against a wound of any kind having ever been inflicted, but that at any rate it is certain there had been no wound involving loss of substance. (*Case* 2.)

A scar may affect the epidermis alone, and not the cutis. If then no signs of a scar are visible on a dead body where putrefaction has set in and the skin commenced to peel, we should be cautious in concluding that no scar existed during life.

2. *How far can the period at which a wound was inflicted be inferred from the appearance of a cicatrix?*

In the case of a simple incised wound of no great extent, and in tissues of active vitality, cicatrization is usually complete in from fourteen to twenty days. Rapidity of cicatrization, however, is dependent on many causes, such as:—

(α.) *The extent of the wound.*—The more extensive a wound, and particularly if the structures involved be several and complicated, the less rapid is cicatrization.

(β.) *The nature of the wound.*—Cicatrization is often complete, as we have said in the case of a simple incised wound, in about a fortnight, but if the parts be contused and lacerated, or if there be actual loss of

substance, then the healing process will proceed by granulation, and occupy a very much longer time.

(γ.) *The position of the wound.*—Thus wounds of the lower extremities heal and cicatrize more slowly than wounds of the upper extremities. Wounds where the absolute rest of the parts can be insured heal more rapidly than wounds on parts (such as near a joint) where a slight and constant motion is almost inevitable.

(δ.) *The age and health of the Patient.*—Thus cicatrization is less rapid in the old than in the young, and in the diseased than in the healthy.

It is necessary here briefly to note the three stages through which the cicatrix passes:—

(1.) A recent cicatrix is soft, tender, and *pink*, or, at any rate redder than the surrounding skin.

(2.) After one or two months or more, the precise time being dependent on the various circumstances mentioned above, the cicatrix becomes harder, less tender, and of a *brownish white* tint (brown discoloration).

(3.) As the age of the scar increases, it becomes less and less sensitive, hard and thick, *white* and shining. These latter are the characteristics of an old cicatrix, but it is impossible to fix the period of their development. When the scars are fully developed, they undergo little change, except that they have a tendency (independently of their original shape) to become more and more linear.

Given, then, a hard, *white*, glistening, non-sensitive cicatrix, although it is difficult to give a *positive* opinion whether the original wound had been inflicted six months or six years before, a *negative* opinion may safely be given that the scar did not result from a wound inflicted two, three, or even four weeks previously.

Given, a *brown* cicatrix, we are scarcely in a position to give a very definite opinion.

Given, a soft, *red*, tender cicatrix, we may say that the chances are against its being of long standing. The various influencing conditions (such as the age, the health of the patient, the probable extent and nature of the wound, etc.) must, in such cases, be carefully considered.

It will be evident, from what we have said, that it is very difficult to fix the date of a wound merely from the appearance of the scar. But if a description of an alleged injury, of the instrument causing it, and of the date when it was said to have been inflicted, be referred to the medical jurist, he should, in most cases, be able to say if the appearances presented by the cicatrix be consistent or inconsistent with the alleged cause and date. (*Case* 1.)

3. *How far can the nature of a wound be inferred from the character of the cicatrix?*

It may be remarked generally that the shape and character of cicatrices depend as much, and often more, on the structure of the part wounded—that is, whether the skin and tissues underneath be tense or loose—than on the actual character of the wound. ("*Ann. d'Hyg.*," 1840, I., 430.)

It will be convenient here to consider in order the character of scars resulting respectively from (α) Accident, (β) Surgical operations, and (γ) Disease.

(α.) *Scars the result of Accident.*

The cicatrices of a straight incised wound involving no loss of tissue, is usually rectilinear. If a wound occurs on a part where the skin is tense, the resulting scar is usually widest in the centre, that being the last part to heal, owing to the elasticity of the skin preserving at this point a greater distance between the surfaces. If the wound occurs in a part where the skin is loose (as in the groin) the cicatrix is, as a rule, perfectly rectilinear.

The cicatrix of an oblique wound is usually more or less semilunar.

The cicatrices of incised wounds, involving loss of substance, or of contused or lacerated wounds, are usually irregular in outline, the surfaces of the scars being depressed, and more or less puckered and uneven. A depressed cicatrix may be taken to indicate a loss of substance of the true skin. The shape of a cicatrix, further, often indicates the weapon used to inflict the wound; although, considering the contraction that commonly occurs during the healing process and the consequent puckering, considerable caution must be exercised in drawing positive conclusions from shape only.

The cicatrix of a stab is commonly triangular. It must be remembered that the cicatrix is usually smaller than the stab wound, and that the stab wound is usually smaller than the instrument causing it.

The cicatrix of a bullet wound, where the pistol was fired *near* the body, is large, deep, and irregular, the chances being that tattoo marks, practically indelible, will be found in the tissue around (*see* p. 164). These are due to particles of gunpowder being carried at the time of the explosion under the skin. If the pistol was fired *at a distance* from the person, the cicatrix of the wound is usually a depressed disc, regular in shape and smaller than the ball which caused it. If the ball has passed through the body, whereby two skin wounds result, the cicatrix of the wound of exit is always larger and more irregular than the wound of entrance. ("*Ed. Monthly Journ.*," 1854, Vol. X., p. 370.)

The cicatrix of a burn will vary somewhat with the form of the heated body applied, whilst the regularity and contraction of the scar will depend on the extent and depth of the burn. If the burn be deep, the cicatrix will be deep with rounded edges: if the burn be extensive, the resulting contraction is often so extensive that considerable deformity will result, however diligent the surgeon may be in his endeavors to prevent it. If no skin be actually destroyed, the burn may then leave little or no scar. Thus the cicatrix of a burn may vary from nothing to almost any extent.[1] (See *Case* 17.)

The cicatrix resulting from the application of a caustic, will depend on the caustic used, and the method adopted in its application. Such scars have usually regular edges, but this will vary (as in the case of burns) almost in an unlimited degree. (*Malle in* "*Ann. d'Hyg.*," 1840, I., 422, and *Güterbock* in "*Vierteljahrss.*," 1873, II., 84.)

Scars from flogging usually appear as faint white lines extending between little circular pits marking the position of the knots of the lash.

(β.) *Scars the result of surgical operations.*

Surgical operations for the most part leave indelible scars. (*Case* 18.)

Marks of bleeding are white and linear, their length being in the direction of the vein. If the operation has been performed properly the scar is oblique. The medical jurist, in deciding that a given scar is due to bleeding, must consider whether it is in such a position (as the bend of the elbow) where the operation was likely to have been performed.

The presence or absence of marks of previous bleedings may constitute important evidence in cases of identity. (*Case* 9.)

Marks of cupping usually present themselves as a series of small, white, symmetrical cicatrices.

The cicatrix of an issue is single, round, and depressed.

The cicatrix of a seton is double, each mark being linear, with a band of lymph connecting the two lines.

Blisters, as a rule, leave no scars, their action being superficial. If, however, they have resulted, as they occasionally do, in suppuration and destruction of the part to which they are applied, marks depending on the extent of the damage effected may result.

The cicatrix of vaccination is an irregular, flat, slightly depressed, honeycombed scar.

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[1] English deserters in the army formerly had a D branded on them, and French deserters the letters TF (travaux forcés). These marks were very permanent.

(γ.) *Scars the result of disease.*

Ulcers leave scars behind them. The cicatrices of *scrofulous ulcers* are irregular and deeply furrowed, with hard and uneven edges. When recent they appear flat, but raised above the skin, and of a bluish red color. They are usually very thin and easily injured. The cicatrix of a *syphilitic abscess* is usually very deep on account of the great loss of substance common in such cases. It is difficult to describe the general character of the cicatrices of different ulcers, so much depending on their locality—that is whether the tissue involved be loose or dense.

Small-pox scars are deep and irregular, and occupy a place much below the level of the skin.

And here we may make one or two general observations touching the inferences to be drawn respecting the nature of a wound from the character of the cicatrix.

Occasionally we are able, by the peculiar appearance of the scar, to say without question the nature of the injury which caused it.

More frequently we must content ourselves with giving an opinion whether the scar in question has been the result of injury or of disease. Case 3 (Smyth *v.* Smyth) illustrates the possible medico-legal importance involved in an opinion of this nature.

In deciding this latter point we must consider not only the *general characters* of the cicatrix, but its *locality*. Thus a scar in the inguinal region suggests a syphilitic abscess:—a scar in the neck, or in the course of the parotid (especially if neighboring glands be enlarged) suggests a strumous abscess rather than violence. A scar from an ordinary venesection will probably be found at the bend of the elbow, whilst that caused by an issue or a seton will most likely be found about the shoulder or nape of the neck.

4. *How far can the extent of the wound inflicted be inferred from the size of the cicatrix?*

The cicatrix of a wound in the case of an adult (that is of one who has done growing) is smaller than the wound that caused it, contraction of the skin taking place during the healing process. Further, as the age of a cicatrix increases, it is disposed to decrease in size, and to become thicker and whiter. But the cicatrix of a wound on a child increases in size (*pari passu*) with the growth of the body. Thus a small vaccination scar in an infant, frequently becomes a cicatrix of considerable size in the adult. A case is recorded by Mr. Adams where the cicatrix resulting from an operation on an infant, doubled in length and width between the ages of 1 and 19. Similarly, as the result of removing a small nævus from the head of an infant, a bald

patch of considerable size is commonly found on the adult. (See *Paget's Lectures on Pathology*, Vol. I., p. 49; "*British Medical Journal*," 1873, II., p. 683, Lecture by Mr. W. Adams.)

5. *Can a cicatrix be obliterated either by time or by artificial means?*

There is plenty of evidence to show that scars resulting from slight incised or punctured wounds,—that is, where the epidermis only has been injured,—or from punctures or cuts which if they have penetrated the cutis have involved no loss of substance, *may* disappear in time. They do not, however, necessarily, nor do they invariably disappear. Casper states that the marks of bleeding may entirely disappear, and moreover that he has known cases where the marks of the scarificator have been obliterated after from two to three years. ("*Gerich. Med.*," Vol. I., p. 113.) Devergie doubts this statement, but admits that the marks become less intense by time. ("*Méd. Légale*," Vol. II., p. 217.) Guy refers to two cases, where the scars of the lancet were distinct after nearly 60 years. The author has seen marks of bleeding which had been performed 26, 30, and even 50 years previously. He also knows of cases of similar marks in young persons that have entirely disappeared within 12 years. In a case under Dr. Turner's care at the London Hospital, there were distinct linear cicatrices one inch long on each side of the spine, resulting from issues (peas) made 30 years previously. There were also cupping marks that, from the statement of the patient, must have been at least 30 years old.

Ogston affirms positively ("*Med. Juris.*," p. 60) that he has known all trace of chancres disappear in six weeks! Of course such cases are extraordinarily exceptional. (*Casper*, Vol. I., p. 103.)

It may be worth noting that the intensity of a cicatrix varies greatly with the health of the individual. This fact may be important in explaining certain apparently contradictory statements respecting a given scar, one person asserting it to be perfectly distinct, and another scarcely visible. The author knows the case of an old cicatrix of a boil, which, although barely visible under ordinary circumstances, becomes exceedingly well marked, and even raised above the level of the skin, when the patient is suffering from dyspepsia. If a scar results from a skin disease or from a wound involving loss of substance—as, *e.g.*, a wound that has healed by suppuration and granulation (that is, otherwise than by the first intention)—it is very doubtful if the scar can be ever obliterated, although it may undergo certain changes which result in its becoming less distinct. Thus vaccination, small-pox, setons, and issues leave marks which are invariably permanent. In *Case* 17 it was contended that a scar from a burn with a red-hot iron

might be obliterated by time. This statement is entirely contrary to the experience of most observers. The reason of the non-disappearance of scars is, according to Mr. W. Adams, twofold—(1) that although the cicatricial tissue is of low organization, nevertheless it is sufficiently organized to maintain itself; and (2) that cicatricial tissue is so different in its characters to other tissues that it is incapable of amalgamation with them. (See "*Brit. Med. Journ.*," 1873, II., 683.)

Mr. B. Squire has referred to a method of removing a nævus by scarifying it with parallel and cross incisions, the skin being first of all frozen with ether spray. He remarks that these multiple linear scarifications are very slightly visible when the cure is complete. ("*Brit. Med. Journ.*," 1878, I., 865.)

(B.) Tattooing.

The operation of tattooing consists in first pricking the skin deeply, and afterward rubbing into the punctures a coloring body of some kind or another. Sometimes the instrument used (which generally consists of two or three sewing needles mounted in a piece of cork and bound round with thread to within a short distance of their points) is dipped into the coloring solution or mixture before each puncture is made.[1] The process results in a considerable amount of inflammation, which commonly lasts a fortnight or more. In about six weeks after the operation, the cuticle scales off, and at the end of two months or thereabouts, the skin assumes its normal character, marked with the various devices suggested by the ingenuity of the operator.

Tattoo marks may be caused *accidentally*. Thus in the case of an injury occurring under circumstances whereby coloring materials (as coal-dust, etc.,) find their way into a wound, a tattoo mark is almost certain to result, unless great care be taken to effect the removal of the foreign body. (*Case* 25.) Under such conditions, the tattooes are, of course, irregular in shape and outline.

Again, in a gunshot wound, when the pistol has been fired near the person, a tattoo of minute and scattered dots of a bluish color is of constant occurrence, the carbonaceous particles being driven into the skin by the force of the explosion. From the more complete combustion of the carbon particles in modern powder, owing to improved manufacture, the absence of tattoo marks can scarcely nowadays be regarded as certain proof that a shot had not been fired close to the person. ("*London Med. Rev.*," 1878, p. 357.)

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[1] It is said that the Australians make deep incisions, and rub clay into them in order to elevate the tattoo.

Again, it often happens in coal-mine explosions, that particles of coal are so driven into the cutis as to effect a perfect tattoo (*see Index*). I have further seen a well-marked tattoo produced by scratches with a steel pen;—also in the case of printers from the use of a carbon ink;—and lastly, in chimney-sweeps from soot finding its way into wounds or cracks in the skin.

It may here be mentioned that four cases are recorded of death resulting from the after-consequences of the operation. ("*Ann. d'Hyg.*," 1870, Vol. II., p. 464.)

A series of cases is also on record where the operation of tattooing resulted in the transmission of syphilis. (*Case* 22.)

The presence or absence of tattoo marks, as in the famous Tichborne case (*Case* 4), often constitutes important evidence in questions of identity. The exact design is moreover at all times worth noting, special marks being chosen by the lower classes for special trades.

In considering this subject the following questions suggest themselves:—

1. *How far is it possible for tattoo marks to become obliterated by time?*

That they may disappear is fully proved:—

Casper ("*Forensic Med.*," Vol. I., p. 106) found that in four of 37 cases the marks entirely disappeared, in two they partially disappeared, and in three they became generally less distinct by time.

Hutin ("*Recherches sur les tatouages*") found that in 47 of 509 cases the marks entirely disappeared in periods varying from 28 to 60 years, whilst in 117 a partial obliteration occurred in periods varying from 10 to 64 years. In the remaining 345 cases there were no signs of fading, although some had been done over 60 years.

Tardieu ("*Ann. d'Hyg.*," 1855, p. 171) found that in four of 76 cases the marks had entirely disappeared. In two of these cases, where the tattooing had been done with vermilion, the marks disappeared after 30 years, whilst in the other two, where Indian ink had been used, 45 and 60 years elapsed respectively, before the obliteration was complete.

We have thus ten years as the *minimum* period when tattoo marks are recorded to have faded.

Seeing in how very few cases tattoo marks become obliterated, the question follows:—

2. ***What are the circumstances under which tattoo marks are likely to undergo natural obliteration?***

The permanence of tattoo marks is specially dependent on two conditions:—

(α.) *The efficiency of the operation.*

If merely the surface of the cutis be penetrated, the marks are far more likely to fade than if the punctures be carried into the substance of the true skin. In other words, the more completely the coloring matter is encysted in or below the substance of the cutis, the less likely it is to fade. It will be evident from this that a tattoo on a thin-skinned person is more likely to disappear than on a thick-skinned. If the operation be well performed, a tattooed skin may, after death, be macerated in water for an almost indefinite time without the tattoo marks being affected. ("*Ann. d'Hyg.*," 1855, Vol. I., 194.) Nor even (so insoluble is the coloring compound formed) does any solvent seem to influence the marks. Indeed, the removal of the cuticle by spirit, water, or other liquid, rather seems to strengthen than to lessen the intensity of the tattoo. (*Rayer* and *Tardieu.*) Hence, after death, the separation of the cuticle by putrefaction, does not interfere with an efficient tattoo.

(β.) *The coloring matter employed.*—Vermilion, indigo, and Prussian blue are the colors most disposed to fade. Cinnabar and common ink rank next in permanence, whilst cobalt and ultramarine, but above all carbonaceous materials, such as Indian and China inks, soot, coal-dust, gunpowder, etc. (all of which produce a bluish-black tattoo), are by far the most permanent.[1]

Of 120 cases of vermilion tattooes examined by the author (in conjunction with the late Dr. Woodman), there were evident signs of fading in 16, whilst in 156 cases, where some variety of carbonaceous matter, such as China ink or gunpowder had been employed, they were unable in a single case, judging from their own observations and from the history given them by the person to discover any indications that the marks had faded since the operation had been performed.

It may here be noted that in the experience of the author the color produced by taking nitrate of silver is absolutely indelible.

It has been remarked by Follin and Professor Meckel that the coloring matter used in tattooing, even after the natural obliteration of a tattoo, may frequently be discovered in the contiguous absorbent glands. (*Confer.* "*Ann. d'Hyg.*," 1870, Vol. II., p. 453, and 1872, Vol. I., p. 423.) Casper confirms this statement, and quotes seven cases in proof. (*Casper*, Vol. I., p. 107.) In the whole of these

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[1] The New Zealander is said to use for tattooing the resin of the Kauri pine, mixed with a red earth. ("*Lancet*," 1872, I., p. 341.)

seven cases, it is worthy of note, cinnabar was the coloring matter employed. Meckel, however, records having found the charcoal used in the operation in the contiguous lymphatic glands. It may, therefore, be worth while in a post-mortem, where a question arises as to the previous existence of a tattoo, to examine the glands in the region where the tattoo was supposed to have existed for coloring matters.

(3.) *Can tattoo marks be obliterated by artificial means?*

They can;—but they cannot, the author believes, be effaced without leaving scars, the result of the means adopted for their removal. For to effect the object in view, substances (such as cantharides, tartar-emetic ointment, etc.) capable of producing suppuration and actual destruction of the skin must be employed. Thus in *Case* 20 a carbonaceous tattoo was said to have been effaced, the prisoner informing Tardieu that the process he adopted, which was successful in six days, was first applying to the skin a paste of lard and acetic acid, afterward rubbing the parts with potash, and lastly with dilute hydrochloric acid. Tardieu by experiment proved that the process described would answer the purpose. He further states (what in my opinion needs verification) that no trace of the design was afterward visible. I have myself operated similarly in two cases, but in both there were distinct signs of the original designs, although so far as the removal of the color was concerned the results were perfect. In *Case* 21 the partial obliteration of a China ink tattoo was effected by the application of a white-hot iron, sufficient marks remaining to allow of its identification. ("*Ann. d'Hyg.*," 1872, Vol. I., p. 423.) It is said that slight tattoos, such as would be produced by pen-and-ink scratches, may be removed by the application of pure carbolic acid. ("*Lancet*," March 30 and April 6, 1872.)

It may be noted here that a fatal case is said to have resulted from an attempt to remove a tattoo by escharotics. ("*Ann. d'Hyg.*," 1855, I., p. 199.)

It is a curious fact that many sailors at the present time seem strongly impressed with the belief that the removal of tattoo marks may be effected by binding upon them a fresh sole-skin. ("*Brit. Med. Journ.*," 1880, I., p. 721.)

It has been stated that tattoo marks in the young may be obliterated by an attack of confluent small-pox or other severe eruptive disease, where the eruption has affected the parts scarred and the region around. ("*Brit. Med. Journ.*," 1871, II., p. 532.)

In examining a part supposed to have been tattooed, a brisk rub of the skin will often render marks apparent that were previously invisible. This plan was successfully adopted by Leroy. ("Ann.

d'Hyg.," 1870, Vol. II., p. 460.) We need scarcely add that this method will be useless after the death of the person.

Summing up the views of the author as the result of the examination of some hundred tattoo marks on persons of different age, sex, and nationality, he believes that if the operation be efficiently performed, and some carbonaceous material or cobalt or ultramarine be employed as the coloring matter, the marks are in an overwhelming proportion of cases indelible, and that even if they do fade, they never entirely disappear. Further, that when vermilion, indigo, or Prussian blue have been used, the marks may be (although they rarely are) obliterated by time. Under any circumstances, however, if artificial means have been adopted to effect the removal of a tattoo, such means are certain to leave cicatrices indicative of some process having been used for the purpose.

Rules for the Examination of Scars, etc.

If the scars be difficult of detection it will be advisable before examination to inquire definitely:—

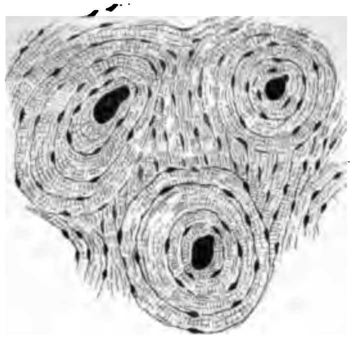
1. Is it certain that the person was originally scarred or tattooed?
2. If so, at what age was the scar seen for certain?
3. With what instrument was the wound causing the scar said to have been inflicted?
4. Was the wound a deep or a superficial one?
5. If a tattoo, what was the coloring matter employed?

Examine with a lens the spot said to have been scarred. (A bright light should be allowed to fall on the part obliquely.)

If no scar be visible, rub the part briskly, or apply firm pressure, or adopt such other means as will redden the sound skin (page 157).

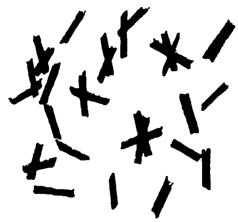
Note—

(α.) *Number of scars.*
(β.) *Size of each scar.* (Measure each scar with compasses.)
(γ.) *Situation* (*e.g.*, the temple, arm, or ankle [suggestive of venesection], the shoulder or nape of neck [suggestive of an issue], etc.).
(δ.) *Form* (*e.g.*, linear, etc., or of irregular or regular outline).
(ε.) *General Appearance* (rough or smooth).
(ζ.) *Color* (white, brown, or red).
(η.) *Consistency* (soft or hard, thin or thick).
(θ.) *Condition* (painful or the reverse).
(ι.) *Relation to surrounding skin* (raised or depressed).
(κ.) *Character of surrounding tissues* (loose or dense).



Bone.

Blood Discs.



Hydrochlorate of Hæmatin. (Hæmin)

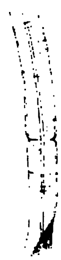
HAIRS &c.

Human

Surface of Human hair.

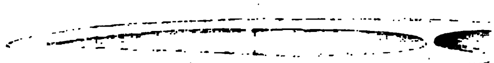
Cotton.

Wool.



Hemp.

Coir.



Jute.

Are the scars such as might have resulted from wounds inflicted at or about the time alleged?

In the case of tattoo marks note:—

(α.) *Part tattooed.*

(β.) *Coloring matter used.*

(γ.) *Design.*

X. Hair and Fibres. (See Plate I.)

(For further drawings of hairs see "*Woodman & Tidy's Handy-book of Forensic Medicine,*" Plates vi. and vii.)

The microscopic examination and identification of hairs and fibres have many times led to the conviction of criminals. (*Cases* 35, 41, 57 to 63.)

Hairs found on the mutilated portions of a skull, or near remains believed to be human, or on a weapon supposed to have caused the death, or clutched in the hands or found on the clothes of a deceased person (the question then being their similarity to the hair of the *accused*), or found on the clothes or person of the accused (the question then being their similarity to the hair of the *deceased*), are some of the cases that the medical jurist may be called upon to investigate.

Again, fibres of different kinds and colors may be found on the weapons supposed to have caused the death, or on the person of the accused, and the question may then arise whether they correspond or not with fibres taken from articles of clothing worn by the deceased at the time of the murder. (*Cases* 58, 59, 60.)

Hairs may frequently be found embedded in blood on a weapon that has been used with murderous violence. Hence, all blood spots, and more especially the edges of the spots, should in the first instance, be examined with a large hand magnifying lens for hair, fibres, etc., before being otherwise treated. If such be found, the blood spot should be digested in distilled water, and the hair or fibre removed intact for microscopic examination.

It is, however, possible for hairs to be discovered on weapons used with murderous violence, without any blood being found upon them. Thus, such an instrument as a hammer might cause a contusion with fatal fracture of the skull, and yet no blood but an abundance of hair be present.

And here it may be noted, that in examining an instrument such as a hammer or a hatchet for hairs, special search should be made at the spot where the iron head joins the wooden handle, and particularly at

points where the wood is found to be splintered. For here the hairs will probably be tightly secured, and what is more, supposing the instrument to have been afterward washed and cleansed to destroy suspicion, they are the parts where the hairs are the most likely to escape removal, and the weapon effective cleansing.

In cases of rape the examination of the hairs about the female genitals may reveal the existence of spermatozoa, which cling to them with remarkable tenacity, even to resisting ordinary washing, unless performed before the seminal secretion has had time to dry. In such case those hairs should be selected for examination that appear stiffened and massed together (*Sonnenschein*). Moreover, loose hairs corresponding to those of the accused may be found on the victim, and hairs corresponding to those of the victim on the accused, and furnish material evidence.

Further, in cases of bestiality, some of the hairs of the animal will invariably be found adhering to the clothes or person of the prisoner.

In all cases, except where the hairs are being examined for adherent spermatozoa, they should first of all be washed in water, then thoroughly dried, afterward steeped for some time in turpentine, and finally mounted in Canada balsam. In ordinary cases they should be examined with a magnifying power of about 200 diameters. Indeed, in the microscopic examination of hairs and fibres, a low power is as a rule preferable to a high one, because it permits the use of polarized light, which is often of great service in such investigations.[1]

One general remark may be made here. The comparison of hair with hair, or of fibre with fibre, as to form, color, length, breadth, etc., yields at all times more valuable evidence, and furnishes data for more exact conclusions, than mere detailed information respecting the microscopical characters of an individual hair or fibre. Hence the actual comparison of the hair in question with hair actually removed from the person to whom it is suspected to belong, should, in all medico-legal cases, be aimed at.

I have found it convenient to keep a series of hairs of different animals, ready mounted, for purposes of comparison. This is preferable to trusting (however familiar we may be with their characters and appearance) either to memory or plates.

We shall consider the subject of hairs and fibres, and such medico-legal questions as may suggest themselves, in the following order:—

1. The structure of, and the effects of reagents upon, hair.

[1] To examine hairs for spermatozoa, moisten the hair first of all with a drop of ammonia solution, and examine under a microscope after the liquid has evaporated.

2. Is a certain material submitted for examination hair, or is it some fibre or other not hair?
3. The measurements of the hair of different animals, and of the hair from different parts of the human body, and from individuals of different age and sex.
4. If a hair submitted for examination be not human, from what animal has it been derived?
5. Has the hair, in a given case, been lately cut or shaved, or has it been torn out violently by the roots?
6. The color of a given specimen of hair.—Has it changed its color naturally, or has it been subjected to a dyeing process?
7. May the hair grow after death?
8. The evidence to be derived from the chemical analysis of the hair in cases of poisoning.

(1.) *The structure of, and the effects of reagents upon, hair.*

Hairs are appendages secreted by the skin—in fact, modified epidermic formations. Each hair is embedded in a depression in the skin (*a hair follicle*), and is fixed at the bottom of the follicle by a dilatation of the hair itself (*the bulb*). The portion above the bulb and within the follicle is termed *the root*, and the projecting portion *the shaft*.

Fœtal hairs are completely shed after birth, the new hairs that replace them being formed in the old follicles.

Hair resists putrefaction in a remarkable manner, its microscopic appearance remaining well marked after an almost unlimited period of time.

(*a.*) *Structure.*—A human hair under the microscope appears to be (although really it is not) tubular—that is, it presents a light centre surrounded by dark sides.

The *outer* or *cortical* part is fibrous in structure, and appears dotted or striated. It gives to the hair both its firmness and color. Treated with sulphuric acid, it breaks up at first into fibres, but ultimately into spindle-shaped, flattened, angular, nucleated cells (1-300th to 1-500th inch long, and 1-2000th to 1-6000th inch broad), containing pigment granules (1-50,000th inch diameter) to which the color of the hair is due.

The *inner* or *medullary* portion of the hair consists of granular, nucleated cells (1-1000th to 1-2000th inch diameter), angular or rounded in form, and arranged linearly. They contain air. This causes them to appear black by transmitted, and white by reflected light. The black appearance presented by the medullary portion when seen by

transmitted light, was the origin of the old notion that the color of the hair was dependent on the medulla, and that the cells were pigment cells.

The whole hair is surrounded by a cuticular coat consisting of flat epithelial scales. The well-marked characteristics of the hairs of different animals depend in great measure on varieties in the arrangement of this cuticular investment.

The hairs frequently found within encysted tumors, in ovarian cysts, and in the stomach, have in all respects the normal structure of hair.

(β.) *Effects of Reagents.*—Hair is roughened by the action of acids. Alkalies produce a similar effect, although they restore the color of hair bleached by acids. Strong alkalies dissolve hair. Alcohol renders hair more or less transparent, but does not effect solution. Soaked in chlorine water or subjected to the action of the gas, hair becomes rotten and more or less disintegrated.

(2.) *Is a certain material submitted for examination hair, or some fibre or other not hair?*

The microscopical and chemical peculiarities of a few of the more common materials with which hair is likely to be confused may be noted here, and in passing it may be said that the characteristics to be described scarcely undergo the slightest change after the lapse of centuries. (See Plate I.)

(*a.*) **Cotton** (*the Hairs from the epidermis of certain seeds*).

Cotton fibres consist of flattened bands, with thickened borders, twisted or spiral. This flattening depends on the cells collapsing when dry, from the absence of a regular thickening layer.

(*b.*) **Linen** (*the liber fibres from the stems of the flax plant*).

Linen consists of round fibres having a woody and firm consistency preventing collapse, with jointed markings at unequal distances (from pitting of the cell wall) and tapering to points. Boiled with nitric acid, they exhibit a very oblique and close striation.

(*c.*) **Silk** (*a substance secreted by the glandular organs* [spinning organs] *of certain insects*).

Silk under the microscope appears as solid, cylindrical, or somewhat flattened fibres, the boundary lines being well defined. They are free from markings of all kinds, and refract light powerfully.

Test for silk.—Linen and cotton are not colored by Millon's[1] or Schultze's test, whilst silk is.

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[1] *Millon's Test Liquid* is a strongly acid solution of the mercuric and mercurous nitrates. The following substances *are turned red* by it, viz., albumen, chondrin, epidermis, feathers, fibrin, gelatine, horn, *silk*, etc. The following (if pure) *are not colored* by it, viz., cellulin, *cotton*, gum, *linen*, etc.

(*d.*) **Wool** (*a variety of hair found in certain of the Ruminantia*).

Wool in certain respects closely resembles hair, but is usually softer, more flexible, and wavy. The fibres are of irregular and unequal thickness. The cortical cells are exceedingly distinct, the cortex in some cases presenting characteristic markings.

[This is the usual appearance of the fibres of cloth, shoddy, alpaca, merino, etc.]

(*e.*) **Hemp** (*the liber fibres of the* cannabis sativa).

The fibres of hemp resemble flax, but are of a coarser nature. Boiled with nitric acid they exhibit no spiral streaks, but swell and become brittle.

(*f.*) **Jute** (*the liber of an East Indian plant,* corchorus capsularis). **Bast** (*the liber of the lime tree*).

Both jute and bast exhibit a clearly vegetable structure, and consist of long glossy fibres with blunt ends. The walls are thinner than in the case of flax fibres. Boiled with nitric acid, no spiral streaks become visible.

(*g.*) **Coir** (*the fibrous tissue of the husk of the cocoa-nut*).

This material is usually found in the form of bundles of small fibres, each fibre having a blunt end. The fibres are perfectly plain and free from all markings. When boiled with nitric acid they exhibit wide and open cross markings.

(3.) *The measurements of the hairs of different animals, and of the hairs from different parts of the human body, and from individuals of different age, sex, and race.*

Hairs from different parts of the human body, as well as from different individuals of the same species, vary considerably in size. This will be seen from the following table, chiefly taken from Dr. Emil Pfaff's work "*Das Menschliche Haar, etc.,*" Leipsic, 1866, quoted by Sonnenschein. The originals have been reduced to fractions of an English inch.

	Fractions of Inch.
Down (lanugo) from a suckling	$\frac{1}{3333}$ to $\frac{1}{960}$.
Down (lanugo) from a young girl's arm	$\frac{1}{1666}$.
Down (lanugo) from the upper lip of a woman	$\frac{1}{1428}$.
Down of beard (iulus)	$\frac{1}{166}$.
Hair from a woman's head (capilli)	$\frac{1}{434}$.
Hair from female pubes	$\frac{1}{166}$.
Hair from a man's head (capilli)	$\frac{1}{333}$.
Hair from axilla	$\frac{1}{166}$.
Hair from male pubes	$\frac{1}{255}$.

	Fractions of Inch.
Hair from the eyelashes of a man	$\frac{1}{565}$.
Eyebrows	$\frac{1}{300}$.
Hair from nostrils (vibrissæ)	$\frac{1}{333}$.
Hair of moustache (mystax)	$\frac{1}{300}$ to $\frac{1}{181}$.
Hair from the ears (tragi)	$\frac{1}{555}$.
Hair from the arm of a man	$\frac{1}{1000}$ to $\frac{1}{565}$.
Hair from a man's hand	$\frac{1}{370}$.

	Fractions of Inch.
Pig's bristle	$\frac{1}{100}$.
Hair of fallow deer	$\frac{1}{250}$.
Hair of horse	$\frac{1}{340}$.
Hair of goat	$\frac{1}{500}$.
Hair of fox	$\frac{1}{600}$.
Hair of cow	$\frac{1}{600}$.
Hair of spaniel dog	$\frac{1}{1100}$.
Hair of rabbit	$\frac{1}{1125}$.

From the above table we note that human hairs have diameters varying from the $\frac{1}{170}$th to about the $\frac{1}{3000}$th of an inch, according to age, sex, and situation. Hairs from the female head are generally finer, softer, longer, and more inclined to curl, than those from the male. Those of children are softer, finer, and more silky than those of adults.

In comparing the hairs of a man with those of an animal or the hairs of one animal with those of another, the following are the chief points to bear in mind:—

(*a*.) *Size*.—Thus the hair of the deer is of greater diameter than the hair of a horse, and the hair of a horse than that of a man. It must further be noted that different hairs on the same man may be of very different size, the hair of the head being finer than the eyelashes, and the hair from the arm finer than that of the head.

(*b*.) *Shape and microscopical appearance*. — (For drawings see "Handybook of Forensic Medicine.") The toothed appearance of certain hairs are due to the arrangement of the cuticular cells.

(*c*.) *The relative proportion of medulla and cortex*.—Thus in the deer and horse we find a great development of medulla at the expense of the cortex, whilst an opposite condition occurs in other animals, such as the camel.

(*d*.) *The locality of the pigment*.—Thus in man and also in the monkey tribe the pigment is confined to the cortex of the hair, whilst

in certain of the rodentia (the mouse and the rabbit for example) it is found in the medulla.

(*e.*) *The arrangement of the medullary cells.*—Thus in the quadrumana the medullary air-cells are larger and less crowded than in the human species. The varieties in this respect are endless.

(*f.*) *The comparative quantity of true hair compared with that of woolly hair or of down.*

Lastly, we note that the hairs of different races have certain special characteristics. ("*Lond. Med. Record,*" 1874, p. 656.)

Founded on his examination, the medical jurist must consider how far the facts he has observed justify him in answering the four following questions certain to arise in the course of evidence:—

(*α.*) *Is the hair submitted for examination human or not?*

As a rule this question is easily answered. If the thin cortical substance of human hair, marked as it is more than that of any other mammal by fine transverse lines with an axis band of spheroidal cells, be compared with the peculiarly shaped hairs of other animals, it will be at once apparent that very little difficulty can arise in the majority of cases to prevent our forming a positive opinion whether a hair is human. (See Professor Œsterlen, "*Ann. d'Hyg.,*" XLVIII., also "*Lond. Med. Record,*" 1878, p. 351.) Still it must be admitted that occasionally the hairs of some of the lower animals—for example, those of a brown dog—present a remarkable similarity to human hair.[1]

(*β.*) *If human, does it correspond or not with other hairs (such as those of the murderer or the victim) submitted to us for comparison?*

We repeat; in all cases the opinions founded on comparing the hairs in question with hairs respecting which there can be no doubt, are of greater value than those based merely on the examination of solitary hairs. The size, color, and general character of the hairs, are the points specially to be observed in such comparisons. The observations to be valuable should be numerous. Correspondence, the result of a single observation, should not be deemed sufficient to prove identity, any more than non-correspondence in a single observation should lead us to assert non-identity. In giving evidence, it will be safer to say that two hairs are *similar*, than that they are *identical.*

(*γ.*) *If human, is it the hair of a male or female?*

This question has been in part answered. Female hairs are usually longer, and the $\frac{1}{3500}$th or $\frac{1}{3000}$th of an inch less in diameter than male hairs. The roots of male hair are from $\frac{1}{300}$th to $\frac{1}{500}$th of an inch

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[1] I have noticed this on several occasions, more especially in the case of the hair of the brown Skye terrier.

wider than the roots of female hairs, and the uncut points are broader. Alkalies, moreover, affect them less.

(3.) *If human, from what part of the body was the hair derived?*

This question may sometimes be settled by noting the diameter and general appearance of the hairs. The hairs of the eyebrows are usually firm at the point, smooth, angular or oval on section, and possess a stout, knob-like bulb. The eyelashes have spindle-shaped roots. Hairs from the nose and ears are coarser in structure, and have stout roots. The hairs of the beard and moustache are generally triangular on transverse section with one convex side, but the shape is much modified by shaving and cutting, as the hairs of the axilla are by the perspiration. The shafts of the latter rise immediately out of the thick roots and do not taper; their points are conical, but not sharp, whilst the color generally is light from the action of the perspiration. The hairs on the back of the hand and on the forearm are commonly modified by friction and soap, which tend to fray them. Their roots are club-shaped. The pubic hairs are generally oval and much flattened, and often present considerable roughness (due to a loosening of the epidermic scales of the cortex), so as to make them appear branched when seen under the microscope. Their roots are knotty (particularly in the male), and the usual rule of size is reversed, those of the female (see Table) being generally broader than those of the male. The roots of the scrotal hairs are particularly long in aged adults.

Although these are the general characteristics of hairs from different parts of the body, the medical jurist should exercise the greatest possible caution in speaking dogmatically as to the precise locality from which hair submitted for examination was derived.

(4.) *If a hair submitted for examination be not human, from what animal has it been derived?*

In cases (as already mentioned) of bestiality this question may be very important. Thus, in a case submitted to me, I was able to say that certain hairs found on the trowsers of a prisoner were the hairs of a horse, and that they corresponded to those of a mare with which the man was accused of attempting intercourse. In this case I also found spermatozoa on certain hairs of the mare, which I had but little doubt were human.

I have frequently been called upon to examine blood stains, in which hairs were embedded, where one was able to say that, from their shape, etc., they were probably the hairs of a certain specified animal.

(5.) *Has the hair in any given case been lately cut or shaved, or if free has it been torn out of the body violently?*

Hair that grows undisturbed tapers gradually to a fine point. Female hairs generally, and the hair of the beard not unfrequently, terminate in two or three branches. After hair has been once cut, the ends never regain their taper condition, but remain more or less rounded. For some days after cutting the hair retains a certain smoothness of section. Hairs pulled out by force generally appear crushed and somewhat frayed, the hair-sheath as a rule in such cases being torn away with the bulb. Epidermic scales from the skin will often be mixed up with the hairs, and blood may also be present in small quantity.

It must, however, be noted that the appearance of hairs lost after fevers and other acute diseases, closely resemble, as regards the conditions of their bulbs and hair-sheaths, those torn out violently.

Certain diseases, such as ringworm and syphilis, and certain poisons, such as arsenic, opium, etc., frequently occasion a loss of hair. Loss of hair may also occur from other causes, such as fright. (*Cases* 66, 68.)

(6.) *The color of the hair. Has a given specimen changed its color naturally or has it been subjected to a dyeing process?*

Dr. Sorby has shown that there are several coloring bodies in hair, the two principal being a black and a red brown, both of which when oxidized change to a yellow. Red hair also contains a pink coloring body. The different colors of hair are due, in his opinion, to an admixture in different proportions of these and some other coloring matters. (See "*London Med. Rec.*," 1877, p. 434.)

Attempts have been made at times to prove paternity by the color of the hair (*Case* 64), a detail of far less value as a matter of evidence than the color of the skin. Indeed, seeing how frequently red-haired children are born of dark-haired parents, and *vice versâ*, one is scarcely justified in regarding the color of the hair in such questions as of any real importance. (Œsterlen. "*London Med. Rec.*," 1878, p. 358.)

The hereditary nature of albinism, a condition characterized by a want of pigment, must be regarded as well proved. Illustrations are numerous where this peculiarity, as we should say, "runs in families." ("*British Med. Journal*," 1880, I., p. 246.) Still its value medico-legally in proof of paternity can only be accepted as of limited value, seeing how frequently a family of Albinos are the offspring of dark and swarthy parents. ("*Lancet*," 1875, II., p. 508.)

The sudden bleaching of the hair by grief or fright, has been much disputed although numerous instances have been quoted. Of these Mary Queen of Scots and Marie Antoinette may be mentioned. (*Cases* 67, 68.)

Allowing for much exaggeration, it has been proved beyond a doubt that certain diseases will at times effect a great change in the color of the hair. And further, that without any apparent cause, a change of color may suddenly occur. Such changes may or may not be permanent, and may or may not be limited in their extent.

Something similar occurs in animals. Thus in the case of the arctic fox, the hair turns white in winter without coming off. In spring the white hair is shed, and dark hair grows, this again passing through the same color change during the following winter. It is also said that some white hairs actually grow in winter. But exceptions to this curious growth and color change occur, for the hair of certain individuals of the arctic fox remains the same both in winter and summer.

Nor again is this effect peculiar to arctic foxes, for a change in the color of the hair has been noticed in the case of wolves, ermine, etc. (See "*Lancet*," 1873, Vol. I., p. 754, for an account of seasonal color changes in the hair of hares. *Mr. Welch.*)

The prolonged contact of the hair of a dead body with decomposing organic matter renders it of a darker color. (*Chevalier.*) Long burial, however, usually has a contrary effect, from the action of moist acids (*Case* 69); but the original color of the hair can in such cases be restored by treatment with ammonia. (*Hauptmann* and *Sonnenschein.* See "*Virchow's Archiv.*," XLVI., iv., p. 502, and *Œsterlen*, "*London Med. Rec.*," 1878.) (*Case* 12.)

In certain manufacturing operations, a change in the color of the hair of the workpeople has been recorded. The greenish tint of the hair of ebony turners and of indigo workers, and the bluish-green tint of the hair of copper smelters, I have myself frequently noticed.

The hair of children grows darker, as a rule, as they advance in life.

We need scarcely do more than point out that the color of the hair may be important as a means (although alone of but little value) of determining age. [See Paper on Grey and White Hair, "*London Med. Rec.*" (*Dr. Wertheim*), 1878, pp. 88 and 358.] It must always be remembered that premature greyness may be hereditary. ("*Brit. Med. Journ.*," 1879, I., p. 999.)

In determining identity it may be important to note that the apparent is by no means necessarily the real color of the hair. (*Case*

65.) This, in the case quoted, was fully investigated by Orfila and Devergie (see "*Journal of Cutaneous Med.*," II., October 7, 1868, p. 330):—

(α.) *Thus light or red hair may be darkened.*—Lead, silver, and (more rarely) bismuth, constitute the principal ingredients of the dyes employed for this purpose. Thus a mixture of equal parts of lime (which removes the fatty matter, and so allows the more perfect action of the dye material) and lead carbonate or oxide made into a paste with water, will change the color of the hair within four or five hours to any shade up to a dense black, the hair itself supplying the sulphur necessary to convert the lead salt into a sulphide.[1] Red hair contains more sulphur than other hair, and by so much the more easily and rapidly in its case is the change effected. (See "*Brit. Med. Journ.*," 1870, II., p. 660.)

Frequently a solution of an alkaline sulphide (potassic sulphide) is first applied to the hair, a weak solution of a silver[2] or bismuth salt (sold as Persian, or Egyptian, or Cyprian water) being afterward brushed in. All such dyes are without exception dangerous. (*Cases* 70, 70*a*.)

In all these cases the metal may be easily detected by treating the hair (after removal) with nitric acid, and testing the solution by ordinary analytical processes.

(β.) *To convert dark into light hair* is more difficult, and requires a much longer time. (*Case* 65.) If the fatty matter in the hair be first removed by an alkali, the free application of strong chlorine water will effect a manifest lightening of tint within two hours; but its use for general purposes (that is, for purposes other than a desire to destroy identity) is impossible, because of the extremely brittle and rotten condition resulting when chlorine water is applied to the hair for a sufficiently long time, or of sufficient strength to be of much service. Further, it requires many applications to get well-marked lessening of color by merely brushing the solution in, although after the hair has been cut off, almost complete bleaching may be effected in a comparatively short time by continuous soaking.

To dye hair the much admired "golden tint," peroxide of hydrogen (*hydroxyl* H_2O_2) is commonly employed. Whenever the brown

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[1] A favorite formula is as follows:—Acetate of lead, 1 grm.; milk of sulphur, 3 grms.; glycerine, 32 grms.; water, 165 grms.

[2] A formula for silver hair dyes is as follows:—Water, 1 pint; silver nitrate, ½ oz.; copper sulphate, ½ drm.; ammonia, a sufficiency. The salts are to be dissolved in 5 ozs. of the water and strong ammonia gradually added till the solution is of a deep blue color, and quite clear. The solution is then to be diluted to 1 pint.

pigment of hair is treated with an oxidizing agent it becomes of a yellow color (xanthophyll).

If the color of hair becomes of importance in determining identity, the use of a dye is suggested—

(*a.*) If the color be marked by want of uniformity.

(*b.*) If the new growth seen at the roots be of a different shade and color to the hair generally. As a fact, it is very rarely that a dye is so efficiently used as completely to change the color over the whole head and down to the very skin. It is where the hair is thickest that the dye necessarily penetrates least, and here at the base the real color of the hair will probably be perceived.

(*c.*) If the color of the hair on the pubes or trunk does not correspond with the color of the hair on the head.

Œsterlen points out that under the microscope dyed hair exhibits a far greater degree of regularity of color than is found in nature. Again, chemical analysis will easily decide the use or not of metallic hair-dyes. The metal has only to be dissolved out with nitric acid when the original color will be restored. Hairs tinged by pomades may be detected by treatment with alcohol or ether, in which such fatty preparations are soluble. If a prisoner's hair has been dyed, his scalp will often be found tinted. In a doubtful case the head might be shaved, and the new growth carefully watched.

(7.) *May the hair grow after death?*—That both the hair and nails may grow for a time after death, has been proved by careful observations. Good (who records cases in proof), Pariset, and Villermé, in the "*French Dictionary of Medical Sciences*" (the former of whom gives a remarkable instance), and Bichat (who states he has himself noticed a lengthening both of the beard and of the nails after death), are authorities in favor of post-mortem growth, whilst Haller contends that the cases where the hair has appeared to grow after death are in reality deceptive, and due merely to a shrinking of the skin. Still that there may be molecular life and fecundity of the epidermis and therefore of the hair follicles for a time after somatic death, is what theory would lead us to expect, and observations are ample in proof. (See *Case* 71.)

(8.) *The evidence to be derived, in cases of poisoning, from the chemical analysis of the hair.*—M. Joannot, in his monograph on "human hair," refers to having found arsenic in the hair of persons who had been poisoned by it. I have no personal experience on this matter, save in one case of arsenical poisoning, where I examined the

hair, but failed to detect the poison. ("*Brit. Med. Journ.*," 1878, Vol. II., p. 811.)

XI. The Teeth.

Questions of identity may turn on the absence or presence of teeth (*Case* 13), or on the condition of the alveolar processes as indicative of the period when the teeth had been removed (*Case* 52), or on the presence of artificial teeth and the mechanical appliances adopted for fixing them (*Case* 34), or on certain other dental peculiarities. (*Case* 42.) In cases of identity, therefore, the state of the teeth, and more especially irregularities in dentition, should be accurately recorded. It is advisable, in an important case, that a cast of the mouth should be taken, so that hereafter any question that may arise respecting the state of the teeth or condition of jaw can be immediately set at rest.

The condition and number of the teeth and the period of dentition, are circumstances of the utmost value to the medical jurist in determining the age of the person.

Mr. Edwin Saunders ("*The Teeth a Test of Age*," 1837) was the first to call attention to the value of the teeth as a method of ascertaining approximately the age of children. It is well known that human beings have two periods of dentition. Table I. shows the number and position of the teeth relatively to each other in each set, and the relation of the temporary to the permanent series, and Table II. the average periods of their eruption.

TABLE I.

ARRANGEMENT OF THE TEMPORARY AND PERMANENT TEETH.

		Molars.	Canines.	Incisors.	Canines.	Molars.		
Temporary Teeth	Upper Jaw....	2	1	4	1	2	= 10	= 20.
	Lower Jaw....	2	1	4	1	2	= 10	

		Molars.	Præmolars or Bicuspids.	Canines.	Incisors.	Canines.	Præmolars or Bicuspids.	Molars.		
Permanent Teeth	Upper Jaw...	3	2	1	4	1	2	3	= 16	= 32.
	Lower Jaw..	3	2	1	4	1	2	3	= 16	

TABLE II.

THE PERIODS OF THE ERUPTION OF THE TEETH.

(α.) *Temporary Teeth.*

6th or 7th	month,	two middle incisors.
9th	"	two lateral incisors.
12th	"	first molars.
18th	"	canines.
24th	"	two last molars.

(β.) *Permanent Teeth.*

6th or 7th	year,	the four anterior or first molars.
7th	"	two middle incisors.
8th	"	two lateral incisors.
9th	"	first bicuspids or præmolars.
10th	"	second bicuspids or præmolars.
11th to 12th	"	canines.
12th to 14th	"	second molars.
17th to 21st	"	last molars or "wisdom-teeth."

As regards the molar teeth, we may assume the seventh, fourteenth, and twenty-first years to be the periods at which the first, second, and third molars respectively will have been cut.

At nine years of age there will generally be 12 permanent teeth, viz., 8 incisors, and 4 molars. At thirteen years there will be 20 teeth, viz., 8 incisors, 4 canines, 4 bicuspids, and 4 molars. In examining 1,046 children of known ages, Mr. Saunders found that out of 708 of nine years of age, 389 had the full development of teeth for their age. But on the principle urged by him, that *where the teeth of one side are fully developed, those of the other side should also be reckoned*, 530 came up to the standard. Of the remainder, none would have varied more than a year from the standard—and these always by deficiency.

Again, of 338 children of thirteen years, no less than 294 might, from their teeth, have been pronounced with confidence to be of that age. Of the remaining 44, 36 would have been judged to have been in their thirteenth year, and 8 at or about the completion of their twelfth year. Mr. Saunders' pamphlet contains the precise data on which these decisions were grounded.

Dr. Woronichen ("*Jahrb. der Kinderheilk.*," Vol. IX.) from the examination of numerous German children, fixes five to seven months for the commencement of dentition. The average of a large number of inspections gives 1.2 teeth in males at eight months old, and 1.0

tooth in females. (See "*Braxton Hicks on Dentition in the two Sexes.*" "*Brit. Med. Journ.*," 1877, I., p. 348.) In rachitic children he considers teething to be about one month late. He also fixes, in the case of healthy children, three years for the end of dentition, but a later period in rachitic children.

As regards the decay of the teeth, the wisdom-teeth are, as the late Chief-Justice Cockburn remarked in the Tichborne trial, "the last to come, and the first to go." The incisors, from their situation, are the most exposed to injuries and accidents, and the bicuspids and first molars are the teeth especially prone to decay.

And this leads us to remark on the *irregularities* of dentition.—(*Vide* "*Med. Times and Gaz.*," 1880, I., p. 383):—

(α.) *As regards the time of their appearance.* Of preternaturally *early dentition* we note that some children are born with teeth, these being generally the central incisors. (*Cases* 73, 74.) In *Case* 74, the mother, curiously, is also said to have been born with a tooth. At certain ages the jaws may normally contain more teeth than even the full number of 32. For instance, we have seen several children between six and seven years of age that had 48 teeth, *viz.*, 20 of the temporary set in a perfect state, and 28 of the permanent set more or less developed and placed behind the temporary teeth which they were to replace.

Of preternaturally *late dentition*, cases are recorded where adults have never cut their teeth. (*Case* 75.) Every one's experience will have furnished him with examples of the wisdom-teeth having been cut late in life.

Instances are not wanting of dentition at an advanced period of life. We lately saw a lady, seventy years of age, who was cutting a canine tooth. In the German "*Ephemerides*" (dec. ij. ann. 3. p. 57), it is stated that a man one hundred and eighteen years old cut a complete front set with excruciating pain, and was seen alive two years afterward!

(β.) *As regards the development of the teeth.* Two diseases under this head are worthy of special note. *Rickets* retards the development of the teeth, more especially of the first set. Many rickety children reach an age of eleven or twelve months without cutting a tooth. *Syphilis*, on the other hand, causes certain peculiarities in the permanent teeth. Unlike rickets, however, syphilis rather hastens than retards the eruption of the teeth, and particularly those of the first set. (See Mr. Hutchinson's Researches, "*Med. Times and Gaz.*," 1876, II., p. 239.)

(γ.) Supernumerary teeth and third dentitions (*Cases* 76, 77) have

been recorded. Even a complete *third* set has been mentioned (John Hunter, "*Nat. Hist. of the Teeth.*" See also the "*Philosophical Transactions*," "*Mason Good's Works*," "*Van Swieten's Commentaries*," and the "*Dictionnaire des Sciences Médicales*," art. "Cas rares.")

XII. Stains.

In questions of identity, more especially in criminal trials, few things hold so important a place as, or involve investigations of greater nicety, than determining the precise nature of various spots or stains found on fabrics, instruments, etc. Before attempting to apply any tests in such cases, record in writing—

(1.) Their number, size, and shape. It should also be noted whether the stains are of the nature of *spots* or *smears*.

(2.) Their exact position on the garment or instrument submitted for examination.

(3.) If upon a fabric, the side of the fabric on which they occur.

It is, moreover, advisable for the medical jurist to place upon all articles sent him for examination a private mark by which he may be able to recognize them readily in the witness-box, and the precise place on each where the stains were found. Much trouble may by this means be saved, as the author knows from experience.

Blood Stains.

[*See Dr. Woodman's and the Author's* "*Handy-Book of Forensic Medicine*" (*Churchill*).] (*See Cases* 78 to 82.)

In examining suspected blood stains, note *their general appearance*. Examine them for this purpose with a large magnifying-glass. If they occur upon a colored substance, they are best seen by artificial light.

As a rule, blood *spots* have well-defined and somewhat raised edges.

The color of blood stains will depend on (1) their age and (2) thickness, (3) the moisture and temperature to which the blood has been subjected, and (4) the kind of material upon which it has fallen. If the blood stain be upon a *polished* body, it generally appears as a dark and shiny spot, easy of removal, with cracks radiating from the centre; but if it occurs upon cotton, silk, or linen, etc., it has usually a more or less stiffened appearance, and feels like a spot of dried gum.

The blood spot should be subjected to three sets of tests, viz.,

microscopic, chemical, and spectroscopic. Of these, however, the last is infinitely the most delicate and the most important.

A. *Microscopic Test.*

1. *The microscopic examination of a blood stain.*—Cut out a small portion of the stained fabric and place it on a microscope-glass. Moisten it with one of the solutions mentioned below,[1] and cover the specimen over with a thin covering-glass. Examine with a ¼-inch power, and measure the corpuscles with a micrometer. (See Plate I.)

All structures associated with a blood stain should be examined with great care: such, for example as hairs, different forms of epithelium (pavement epithelium from the vagina being generally found in menstrual blood), biliary or fæcal matter, brain tissue, spermatozoa, etc. By noting these, some clue may possibly be found to determine the source of the blood.

2. The *character of the corpuscles.* The blood-corpuscles in man and in all mammalia (excepting the camel tribe) are circular, flattened, transparent, non-nucleated cells presenting (as generally seen) concave sides with a central bright spot. This bright spot, however, by a slight change of focus or of light may be made to appear shaded.

The diameter of the blood-corpuscles in man varies from the 1-2800th of an inch to the 1-4000th, 1-3200th being an average. They have an average thickness of the 1-12,400th of an inch. The blood-corpuscles of embryonic life are usually larger, and sometimes nearly double the size.[2]

These corpuscles vary in size and shape in different animals. In the camel tribe, although they are about the size of the corpuscles of other mammalia, they are not round but oval and contain no nuclei. In birds, reptiles, and fish the corpuscles are also oval, but they are of

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[1] Water on account of its swelling the corpuscles cannot be used for this purpose. The following solution is recommended:—Glycerine, 1 part; water, 7 parts. (The sp. gr. of the solution should be 1030.) [This solution may be rendered faintly acid with advantage. See "*Amer. Journ. of Med. Sciences,*" Vol. LXVII., p. 128.]

Other solutions suggested by various experimenters are as follows:—

1. Half per cent. solutions of common salt.
2. Sodic chloride, 4 parts; egg albumen, 300 parts; water, 2,700 parts.
3. A 32 per cent. solution of potassic hydrate.
4. Chloral hydrate solution (1 to 10 of water) recommended by Pacini.

[2] Malinin (Virchow's "*Archiv.,*" LXV.) says that if the blood-corpuscles after treatment with 32 per cent. solutions of potassic hydrate have a diameter less than 0.006 millimetre (= 0.000236 inch), the blood is probably not human. If it be above 0.007 millimetre (= 0.000275 inch) it probably is human. If it be between 0.005 and 0.006 millimetre (= 0.000196 and 0.000236 inch) it is not the blood of the goat, sheep, or ox, but it may be of the dog, pig, or possibly of man.

comparatively large size (more especially in reptiles), and distinctly nucleated.[1]

It is worth noting that oval corpuscles may be rendered globular by treatment with an excess of water.

The outlines of dried blood-corpuscles are irregular and jagged, and more or less stellate. At times they seem to be so agglutinated that no treatment will effect their separation.

3. The *bodies likely to be mistaken for blood-corpuscles.*
   - α. *Starch-cells.* These may be distinguished by their behavior with polarized light. A solution of iodine turns them of a blue color.
   - β. *The sporules of certain fungi.* These may be distinguished by their power of refracting light. On the application of iodine a distinct nucleus at once becomes apparent.
   - γ. *The discs found in certain coniferous woods.* These may be distinguished by their size, the double ring that surrounds the pits, the formal arrangement (in rows) of the cells, and the presence of woody fibres.

Lastly, admitting the value of Richardson's (of Pennsylvania) laborious researches on the size of the blood-corpuscles of different animals, it would in our judgment be exceedingly unwise to hazard an opinion as to the source of a given specimen of blood from the microscopic measurement of the discs. And this more especially considering that as a rule where evidence of this kind is needed, the measurements have to be made after treating the dried corpuscles with some liquid reagent. ("*Lancet*," 1875, I., pp. 321, 700.)

B. *Chemical Tests.*

Before considering the chemical and spectroscopic tests for blood, it is advisable to examine the chemistry of its coloring matter.[2]

The coloring matter of blood was originally described by Lecanu under the name *hæmatin.* To Professor Stokes belongs the credit of having proved that Lecanu's hæmatin differed from the coloring mat-

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[1] For numerous detailed measurements, see the author's and Dr. Woodman's "*Handy-Book of Forensic Medicine and Toxicology,*" pp. 599 and 600. Also Mr. Gulliver's Paper in "*The Proceedings of the Zoölogical Society.*"

[2] Struve (Virchow's "*Archiv.,*" LVI., p. 423) states that there are two coloring matters in blood. One is soluble in water and in alcohol, but is insoluble in ether. It is greenish brown when dry. Hæmin crystals cannot be obtained from it. The second coloring body is insoluble in water, alcohol, ether, chloroform, or acids, but is soluble in weak alkalies, and yields hæmin crystals by proper treatment.

ter of fresh blood. Stokes named this coloring matter *cruorine*, and he further proved that it was capable of existing both in a *deoxidized form*, which he called *purple cruorine*, and in an *oxidized form*, which he called *scarlet cruorine*. This cruorine has been known at various times by the names *hæmatoglobulin*, *hæmatocrystallin* *oxy-hæmoglobin*, but is now more commonly called *hæmoglobin*.

In arterial blood we find oxidized hæmoglobin (scarlet cruorine), and in venous reduced hæmoglobin (purple cruorine) combined with more or less oxidized hæmoglobin. In blood taken from a dead body, provided access of air to the blood be prevented, we obtain the spectrum of reduced hæmoglobin only. (*Hofmann*, "*Vierteljahr. Gericht. Med.*," Vols. XXV. and XXVI., also "*Lond. Med. Record*," 1878, p. 461.) But there are exceptions to this general post-mortem condition of the blood-coloring matter, viz., after poisoning by hydrocyanic acid, after death from cold and starvation (in which case the reducing power of the tissues is greatly diminished), and particularly in carbonic oxide poisoning, when the blood exhibits the peculiar spectrum of carbonic oxide hæmoglobin. In cases moreover where death has resulted from the admission of air into the veins, the spectrum of oxy-hæmoglobin will probably only be found for a short time after death. (Schmidt, see "*Lond. Med. Record*," 1874, p. 729.)

The properties of hæmoglobin require careful study. It is remarkable for its indiffusibility. It is perfectly soluble in water and in weak alcohol, but is decomposed both by acids and alkalies, when the body now called *hæmatin* ($C_{600}H_{960}N_{154}FeS_3O_{179}$), together with an albuminous principle, is formed. According to Preyer, nearly the whole of the iron of the blood is contained in hæmatin as an essential ingredient.

There are reasons for believing that some differences exist in the hæmoglobin obtained from the blood of different species of mammalia, the crystals varying much both in their solubility and crystalline form. ("*Blut Krystalle*," W. Preyer, Jena, 1871.)

By the action of alkalies and of acids generally (but not, it should be noted, of hydrocyanic acid), *hæmoglobin* undergoes conversion into *hæmatin*. This change is chemical and permanent. The important fact, however, to be observed is, that a similar change takes place after the blood has been kept for a long time. The fresh blood stain is bright red (hæmoglobin); the old blood stain is brown (methæmoglobin or hæmatin). Further, hæmatin, whether produced by age or by the action of acids, is, like hæmoglobin, also capable of existing in two states of oxidation, each state having its special spectrum bands.

Hæmoglobin is a very soluble, and hæmatin a very insoluble body. This fact is one of great medico-legal importance. After an article

once stained with blood has been washed in water, provided sufficient time has elapsed for the hæmoglobin to be converted into hæmatin, enough will in all probability remain to serve for its identification. But if the stain be perfectly recent, that is before the hæmoglobin has had time to be converted into hæmatin, the whole of the blood may be removed so effectually from the stained fabric by efficient washing in cold water, that no trace will be found. Hot water, however, will not effect the removal of the fresh blood stain like cold water, owing to its further action on the blood-coloring matter. Hence, if in a criminal case it can be proved that an article has been washed in *cold water*, evidence to show the *absence* of blood stains on the article in question is of but little value. And again if the blood-stained article has been washed in *hot water*, the probability is that the medical jurist will find no difficulty in satisfactorily proving the presence, and determining the nature of the stain.

The age of a stain is no impediment to the spectroscopic test. It is probable that hæmatin, although a very permanent body, does undergo certain changes by time, which at present are but little understood. These changes are not, however, of any practical moment, inasmuch as Dr. Sorby states he has been able to discover the hæmatin bands after forty-four years, whilst I have myself obtained excellent spectra from stains I have good reason to believe were over a hundred years old.[1]

But there is a body intermediate between hæmoglobin and hæmatin formed by the exposure of blood to the air for a shorter period than that required to determine the actual formation of hæmatin. This substance, originally termed by Sorby *brown cruorine*, is now called *methæmoglobin*. There is reason to think that methæmoglobin consists of hæmoglobin loosely combined (as Sorby expresses it) with an extra supply of oxygen (peroxidized hæmoglobin).

Changes affected by Time on the Color of Blood Stains.

And here, briefly, we must consider the changes effected by time on a blood stain:—

The *fresh blood stain* (if upon a white fabric) has a bright red color, due to the *hæmoglobin*.

If the stain be kept dry, it becomes in time of a brown color, due to the formation of *methæmoglobin*.

This change of hæmoglobin into methæmoglobin varies according

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[1] These stains were on a garment preserved by the relatives of an officer who was said to have met his death in battle in the year 1771.

to circumstances. Thus in towns it is rapid, but in the country slow. The alteration is specially rapid when the stain is exposed to an atmosphere in which coal gas is burnt, any weak acid body tending greatly to accelerate it. The change again is rapid when the stained fabric has been worn next the skin, the alteration in such case being hastened by the action of the weak acids of the perspiration.

Finally, *after a time*, more especially if the stain be kept in a damp place, the hæmoglobin is changed into *hæmatin*, or both hæmoglobin and hæmatin may be decomposed.

This rule, therefore, is a safe one:—*If the color of the blood stain be bright red, it is a proof that the stain is recent; but if it be brown, it is no proof that it is old.*

We shall hereafter enlarge on the characteristics of carbonic oxide blood, and of the spectrum produced by carbonic oxide hæmoglobin. It is important to note, however, that if blood saturated with carbonic oxide be placed in a vacuum at a temperature ranging from 98.6° to 140° F. (37° to 60° C.), it slowly but entirely expels the carbonic oxide, ordinary reduced hæmoglobin only remaining. (See "*Lancet*," 1873, I., p. 347; also "*Edin. Med. Journ.*," XIX., p. 80.)

Chemical Tests for Blood Stains.

Blood stains are insoluble either in strong alcohol, ether, chloroform, or oils.

Note particularly the *action of cold water* on blood stains:—

(α.) If the stain be *recent*, and upon a material incapable of combining chemically with any of the blood constituents, it will be rapidly dissolved by the water, the solution becoming of a rich red or brownish red color.

(β.) If the stain be *not fresh, but still comparatively recent*, it is less rapidly dissolved by the water, and yields a solution of a dirty brown color.

(γ.) If the stain *be very old*, it will be insoluble in water, the soluble hæmoglobin having been completely changed into the insoluble body hæmatin.

All our chemical tests for blood have special reference to the action of reagents on the coloring matter of the blood.

Treatment of the stain.—(α.) If the stain be upon *a fabric, such as cotton, linen, silk*, etc., cut a portion out, and treat it with cold distilled water.

(β.) If the stain be upon a porous body, such as wood, brick, etc., the stained part should be scraped off for some depth, and when re-

duced to a fine powder, digested for a considerable time in cold distilled water.

In either case filter the liquid, but preserve both the matters on the filter-paper and the filtrate for examination.

(γ.) If the stain be upon *iron or steel*, probably it may be peeled off, but if this is not possible, it must be scraped. These scrapings consist of a mixture of blood and iron. Digest them for several hours in cold distilled water, rendered slightly alkaline with ammonia, or should this fail in effecting solution, a *trace* of citric acid may be used instead. Filter. The blood-solution will pass through, and the iron, except a trace of citrate, if citric acid has been used, be left on the paper.

[It is well to remember that the coloring matter of blood is rapidly changed from the soluble into the insoluble form by the action of oxide of iron. Hence a blood stain on the *handle* of a knife or axe, may present a very different color and appearance to one on the *blade*, although both were produced at the same time.]

The reactions of the blood-solution thus obtained, constitute a series of important chemical tests requiring special study :—

(α.) *Heat a small quantity in a test-tube to about* 149° F. (65° C.). Note with a blood-solution three results:—(1) The red color is destroyed; (2) the solution is coagulated; (3) a thick brown precipitate is produced, the amount depending on the strength of the solution.

(β.) If this brown precipitate is present in quantity, it should be collected upon a filter paper, dried, and heated with a weak ammonia solution, in which, if blood, it will be soluble. The solution, if sufficiently strong, will appear dark green by reflected and red by transmitted light.

(γ.) *Tincture of galls.* A red precipitate. This reaction is important, inasmuch as all red coloring matters due to iron yield a dark, or bluish green precipitate.

[In the case of a stain removed from a steel blade, etc., more especially if citric acid has been employed for the purpose, this test cannot be used, owing to the dark color resulting from the action of the reagent on the iron dissolved by the acid.]

(δ.) *A very weak solution of ammonia.* If the red solution be blood, the color will either remain unchanged, or if changed, be slightly intensified and reddened.

[If too much ammonia be added, or if the solution be too strong, the red liquid will change to a brown. But the red color of blood *never becomes* green, as happens with the juices of red fruits, nor

crimson, as happens with the coloring matters from cochineal, logwood, Brazil wood, madder root, etc.]

(ε.) *A solution of chlorine* effects no change on the coloring matter of blood, if the chlorine solution be but moderately strong.

[A blood solution, moreover, is not easily bleached by a *solution of sulphurous acid.*]

(ζ.) *Strong nitric acid.* The blood solution becomes of a dirty brown color. If the coagulated mass formed be sufficient in quantity, heat with strong nitric acid, when a clear yellow solution will be obtained.

(μ.) If a solution of sodic hydrate (10 grs. to 1 oz.) be added to blood, a dark olive discoloration results, which on treatment with an excess of acetic acid changes to a red. ("*Edin. Med. Journ.,*" XIX., p. 179.)

Guiacum Test. (Day's.)—Wet the blood stain with *freshly prepared* tincture of guiacum, and then add a small quantity of an ethereal solution of hydroxyl.[1] If the stain be blood, a characteristic blue tint will be produced.

If the material stained be of such a color as to obscure the reaction, add the several reagents, and afterward press the fabric between two pads of white blotting-paper, when the blue color will be absorbed by the paper. A number of impressions may in this manner be obtained, and the reaction be rendered apparent.

If the blood be fresh, the reactions may be obtained by simply treating a solution of the coloring matter in cold distilled watèr with the guiacum and hydroxyl.

To detect blood in urine the following process has been suggested: Mix together in a test-tube equal parts of turpentine and tincture of guiacum. Then add the urine, so that it may flow to the bottom of the tube. The guiacum resin, which now separates if blood be present, becomes of an intensely blue color.

In this test the blue color results from the oxidation of the guiacum resin. But it is important to note that guiacum is blued by a great number of substances, such as by gluten, milk, and the fresh juice of various roots and underground stems (horse-radish, colchicum, carrot, etc.); also by nitric acid, chlorine, the chlorides or iron, mercury, copper and gold, the alkaline hypochlorites, and a mixture of hydrocyanic

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[1] To prepare *the tincture of guiacum*, wash the tears of guiacum resin first with a little alcohol, and then dissolve the pure unoxidized resin by shaking up with a little fresh spirit.

The ethereal solution of hydroxyl is prepared by mixing together equal parts of ether and hydroxyl. The ether is not, however, necessary for the reaction.

acid and sulphate of copper; also by pus, saliva, and mucus mixed with carbolic acid or creosote, etc., etc.

Although the guiacum test is neat and beautiful, it should never be relied upon *by itself alone*, as positive proof of a stain being blood.

Teichmann's Test, as modified by Neumann.—Thoroughly rub together the dried blood and common salt. Treat the mixture with glacial acetic acid, and cautiously evaporate the solution until solidification commences. Cool the slide rapidly, and examine it with ¼-inch objective, when crystals of hæmatin and of the hydrochlorate of hæmatin (brownish black or reddish brown rhomboids or tabular crystals), together with crystals of sodic chloride (transparent cubes), will be apparent. (Plate II.)

The experiment may also be made without employing sodic chloride (Casper).

In the case of a stain, it should be placed on a glass slide and moistened with a solution of sodic chloride. It should then be covered over with a large thin glass, and glacial acetic acid allowed to run under the edge. The liquid is then to be heated to dryness at a boiling temperature, and the slide allowed to cool. When cold, rhomboidal crystals of hydrochlorate of hæmatin, together with crystals of sodic chloride dispersed through irregularly shaped albuminous masses, will be seen.

It is stated that the character of the network in which the crystals are dispersed, varies with different animals, forming characteristic pictures. ("*Amer. Journ. of Med. Sciences*," LX., p. 572.)

C. *Spectroscopic Examination.*

[See Dr. Sorby's Papers in "*Med. Press and Circular*," July 26, 1871, and in various Journals and Transactions of Societies.]

(Confer *Cases* 79 to 82.)

The best instrument to use in examining blood spectra is the binocular micro-spectroscope invented by Dr. Sorby, and now made by Messrs. R. & J. Beck, of Cornhill.

The Spectra produced by Blood. (See Plate II.)

Of these the four following are the most important:—

(1.) *The spectrum of oxy-hæmoglobin* (*the coloring matter of arterial blood*).—The blue end darkened. Two absorption bands visible in the yellower half of the green. The band nearest the violet end is about twice the breadth of the other band.

(2.) *The spectrum of deoxidized hæmoglobin* (*the coloring matter of venous blood*).—The blue end darkened, but somewhat less than in the case of oxy-hæmoglobin. A single broad absorption band visible in the green.

(3.) *The spectrum of blood after short exposure to air* (*methæmoglobin*).—The blue end darkened. The two bands of oxidized hæmoglobin much weakened, whilst a third band is visible in the red.

(4.) *The spectrum of reduced or deoxidized hæmatin.*—The blue end darkened. Two well-defined bands visible in the green, somewhat nearer the violet than those of hæmoglobin. The band nearest the red end is the narrower, but it is intensely black,. and has exceedingly well-defined edges. The band nearer the violet is nearly double the width of the other band, but the edges are less distinct. This band may possibly not be seen in very weak solutions.

Examination of a Recent or Comparatively Recent Blood Stain on a White Fabric.

Cut out a small piece of the stained fabric, and soak it for about ten minutes in a few drops of cold distilled water in a watch-glass. Squeeze the colored fluid out, and stand the solution on one side, so that insoluble matters may be deposited. Introduce the solution by means of a fine-drawn pipette into an experimental glass-cell made of barometer tubing. Fill, if possible, several experimental cells with the solution.

(1.) *Examine the aqueous solution with the micro-spectroscope.*—If the blood be tolerably fresh, the spectrum of oxidized hæmoglobin with its two well-defined absorption bands in the green will be apparent. If such a spectrum be obtained it is certain that the stain was tolerably recent.

(2.) *Add to the solution in the cell first a trace of ammonia*, and then a minute fragment of the *double tartrate of potash and soda* (Rochelle salt). So far no change will be apparent. Now stir in a piece (say about the 1-40th of an inch) of the *sulphate of iron and ammonia* (avoiding as far as possible exposure of the solution to air) and cover the cell over with a piece of thin glass. The two bands will now be replaced by a single intermediate band, fainter but broader than those previously existing (spectrum of reduced hæmoglobin).

The hæmoglobin thus reduced, may be oxidized by exposure to air together with vigorous stirring, and again deoxidized by a further addition of the iron salt.

This deoxidation and reoxidation of the hæmoglobin constitutes a

very characteristic reaction, and serves to distinguish blood from all other substances.

The reduction of the hæmoglobin may be effected spontaneously, and without the addition of any reagent, by merely covering the solution over with a thin piece of glass, and keeping it for some time in the sealed cell.

(3.) Stir into the solution contained in the experimental cell a minute fragment of *citric acid*. This converts the hæmoglobin into hæmatin. The bands of the oxidized hæmoglobin will now disappear, and if the solution be tolerably strong, a faint band become visible in the red. Add now an excess of ammonia. The band in the red, if present, will disappear, the original bands either not reappearing at all, or, at most, only appearing to a very slight extent. This is a most important change, since it shows that the acid has effected a permanent alteration in the original blood-coloring matter. Add now to the solution in the cell a very small particle of the double sulphate of iron and ammonia, and cover over immediately with a thin glass. After a variable time (say in about fifteen minutes), the excessively well-marked and unique spectrum of reduced hæmatin will become apparent, the band at the red end being the first to appear.

By exposing this solution of deoxidized hæmatin to the air, assisted by vigorous stirring, we may often succeed not only in bringing back the oxidized hæmatin band, but also (provided the conversion of the hæmoglobin in the first instance was incomplete) the bands of oxidized hæmoglobin.

Examination of Old Blood Stains, and of Blood Stains on Colored Fabrics.

If the blood stain be *old*, either citric acid or ammonia (the latter by preference) should be used for dissolving the coloring matter. If the fabric be colored, that reagent should be employed which possesses the least action on the dye. If the stain (as sometimes happens) be found insoluble both in ammonia and citric acid, it should first of all be acted upon with ammonia, and a moderate heat afterward applied. The solutions obtained are then to be examined in the manner already described.

The presence of mordants frequently necessitates some alteration in our proceedings, the blood being very likely to become incorporated with the mordant, more particularly if the stained fabric has been wetted. In such case, filtration or allowing the subsidence of the deposit, is equivalent to removing the blood-coloring matter. The same de-

tails must be carried out as have been already described, and the turbidity of the liquid overcome, not by removing the precipitate, but by increasing the intensity of the transmitted light.

Before leaving the treatment of recent and of old blood stains, I would direct attention to the method of procedure suggested by Dr. Richardson, of Pennsylvania, which he describes as follows:—

"Procure a glass slide with a circular excavation in the middle, called by dealers a 'concave centre,' and moisten it around the edges of the cavity with a small drop of diluted glycerin. Thoroughly clean a thin glass cover about one-eighth of an inch larger than the excavation, lay it on white paper, and upon it place the tiniest visible fragment of a freshly dried blood-clot (this fragment will weigh from one twenty-five-thousandth to one fifty-thousandth of a grain). Then with a cataract-needle deposit on the centre of the cover, near your blood-spot, a drop of glycerin about the size of this period (.), and with a dry needle gently push the blood to the brink of your microscopic pond, so that it may be just moistened by the fluid. Finally, invert your slide upon the thin glass cover in such a manner that the glycerined edges of the cavity in the former may adhere to the margins of the latter, and, turning the slide face upward, transfer it to the stage of the microscope.

"By this method, it is obvious, we obtain an extremely minute quantity of a strong solution of hæmoglobin, whose point of greatest density (generally in the centre of the clot) is readily found under a one-fourth-inch objective, and tested by the adjustment of the spectroscopic eye-piece. After a little practice it will be found quite possible to modify the bands by the addition of sulphuret of sodium solution, as advised by Preyer.

"In order to compare the delicacy of my plan with that of Mr. Sorby, a spot of blood one-tenth of an inch square may be made on a piece of white muslin, the threads of which average one hundred to the inch. When the stain is dry, ravel out one of the colored threads and cut off and test a fragment as long as the diameter of the filament, which will of course be a particle of stained fabric measuring one-hundredth of the minimum-sized piece directed by Mr. Sorby. When the drop of blood is old, a larger amount of material becomes requisite, and you may be obliged to moisten it with aqua ammoniæ, or with solution of tartrate of ammonium and protosulphate of iron; but in the criminal case referred to, *five months* after the murder, I was able from a scrap of stained muslin one-fiftieth of an inch square to obtain well-marked absorption-bands, easily discriminated from those produced by a solution of alkanet-root with alum and those caused by infusion of cochineal with the same salt."

Of this process which I have carefully tested, I can say that it works well with fresh stains, but I have failed to obtain the satisfactory results by it with old blood stains that I have by following the processes suggested by Sorby.

Examination of Stained Fabrics that have been washed after staining, and the treatment to be adopted in the examination of the Water used for washing them.

Cold water, as we have already pointed out, may effect the complete removal of a fresh blood stain from a fabric, but not of an old one (p. 189).

In many cases, after a stained fabric has been washed with water, the blood will be found spread over a considerable surface. Under such circumstances a large piece of the material should be removed, and digested with a proportionately large quantity of ammonia or of citric acid, the solution being afterward concentrated by evaporation at a gentle heat.

If the water used for washing such materials has to be examined, it should first of all be concentrated. If, however, it is found that any deposit forms in the water during concentration, this should be carefully collected, acted on with ammonia, and heat applied if it be insoluble in the cold.

If the recently stained fabric, however, be washed with *soap and water*, the hæmoglobin will be rapidly converted (by the action of the alkali) into hæmatin. The probability is, therefore, that after a blood stain has been washed in soap and water, there will be little difficulty in detecting blood on the fabric by ordinary means.

It may sometimes be necessary to examine the soap-water itself. This may be done as follows:—Agitate the soap-water with a large bulk of ether, and allow the mixture to stand until the ether has well separated. Remove the ether with a pipette, and again and again shake up with fresh ether until the aqueous solution is perfectly clear. The solution remaining is then to be concentrated, and examined as usual for blood.

Examination of Stains on Leather.

Blood stains on leather, or upon any substance that contains tannic acid, require special management, owing to the certain precipitation of the coloring matter. Further, the serum frequently soaks into the leather, leaving the blood-corpuscles on the surface. In such case, proceed as follows:—

(*a.*) Shave off a fine slice from the stained portion of leather so

that there may be as much blood but as little leather as possible on the shaving. Bend this shaving so that the stained side only may be brought into contact with water placed in one of the experimental cells. In this manner a solution of the blood-coloring matter may probably be obtained.

Dr. Sorby suggests, however, that if the leather has been washed after the blood has dried upon it, it would probably be impossible to obtain the blood spectra by the method just described. The following process in such case has been found to work satisfactorily:—

(β.) Digest the stained leather in a mixture of 1 part (by measure) of hydrochloric acid and 50 of water for twenty-four hours. This will effect a solution of the mixed compound of the blood-coloring matter and tannic acid. The acid liquid is then to be poured off, but not filtered. The solution may appear almost colorless, or of a slightly yellow tint. Add to this an excess of ammonia, when the color will become either a pale purple or a neutral tint, the tint-shade being considerably intensified on the addition of the ferrous salt and double tartrate, which are now to be added. The solution is then to be examined in an experimental cell, using a light sufficiently intense (such as the lime-light or direct sunlight) to penetrate the turbid solution. Under these circumstances, the spectrum of deoxidized hæmatin will become visible. If the liquid be too turbid to allow even a direct ray from the sun to be reflected through it, the cell should be placed for a few minutes in a horizontal position, so that a *little* of the deposit may subside, always remembering, however, that the removal of the deposit destroys the intensity of the spectrum, the greater part of the hæmatin existing as a compound insoluble in dilute acid.

Examination of Blood Stains on Earth and on Clothes soiled with Earthy Matters.

Digest the stained earth for some hours in a considerable quantity of ammonia. This solution is to be poured off and concentrated, the spectroscopic examination being conducted on the *turbid* solution, using for this purpose an intense light, such as the lime-light or direct sunlight. A similar process should be adopted in the case of *stained fabrics soiled with earthy matters.* This is important, inasmuch as the coloring-matter of the blood is completely carried down by contact with earthy matter.

Examination of Urine for Blood.

The urine, if turbid, must be filtered. The matters on the filter paper, in order to prevent the loss of red corpuscles, should be thor-

oughly washed with cold distilled water. Either examine this latter filtrate by itself, or add it to the filtered urine. The urine is then to be placed in a glass tube six inches long and a quarter of an inch diameter, closed at both ends. The liquid must be diluted until the green of the spectrum can be distinctly seen through the micro-spectroscope. One drop of blood in a pint of urine may in this way be recognized.

One half of the matters on the filter paper should be acted on with alcohol acidulated with sulphuric acid, and the other half with alcohol acidulated with ammonia, and the solutions obtained examined separately in the manner already indicated. (See "*Brit. Med. Journ.*," 1879, II., p. 85.)

General Precautions to be observed in conducting Micro-spectroscopic Observations.

We now add a few words of general advice, and a few precautions necessary to be observed, in examining blood stains by the spectroscope:—

1. If the fabric on which the blood stain occurs be colored, the spectrum produced by the coloring matter extracted from unstained portions of the fabric should in the first instance be examined. Further, it is well to commence our investigations by placing a little blood on an unstained portion, and, when dry, examining the spectra. We shall thus determine, before commencing experiments on the stained portion, the spectrum of the dye itself, and any possible interference likely to result on the blood spectrum.

2. On no account decide that an observed spectrum from a suspected stain is due to blood, unless it *exactly* coincides with bands produced by a known solution of blood, of equal strength, and treated in a similar manner. For this purpose it is advisable to have ready for use several hermetically sealed tubes of deoxidized hæmatin, of different strengths.

3. In all cases examine the spectra both by daylight and by artificial light. We prefer artificial light for general work, but in every case it is advisable to try both means of illumination. Direct concentrated sunlight or the lime-light should be tried whenever the solution is thick and turbid.

4. Never be content with observing a single spectrum of blood. Remember, further, it is often impossible to obtain the unaltered blood spectrum. Hence, never satisfy yourself that a stain is not blood, until you have failed to obtain all the spectra produced by the action of appropriate reagents.

5. If the liquid under examination be *too strong*, so much light will be cut off that the absorption bands may be obscured. If the solution be *too weak*, the bands will become so faint, that they are likely to be overlooked. Practise in this matter to obtain the happy medium. Never, if it be possible further to confirm the result, be satisfied with the examination of a single solution, but examine several of different strength.

6. Use excessively minute quantities of the several reagents. Hæmatin produced by an acid is not very soluble in a strong solution of citrate of ammonia. If you add too much of an iron salt, the precipitate formed so obscures the field as to mask the absorption bands.

7. Adjust the width of the slit during the spectroscopic examination. All absorption bands are best defined when the slit is very narrow. If the bands are very faint, they may only be seen at the moment that the slit is being completely closed.

8. Remember that, with our present knowledge, the spectrum microscope affords no information whatsoever whether the blood comes from man or beast, nor the class of animals from which it is derived, nor, if human, does it enable us to hazard a conjecture as to its origin.

The following questions are likely to be asked where the nature of stains is in dispute:—

1. *Are you certain these stains are blood?*

To this question the medical jurist should, as a rule, have no difficulty in returning an absolutely definite Yea or Nay. Again I repeat, it is the spectroscopic test on which the chief reliance should be placed, all other tests being merely confirmatory. And further, no one should venture to give positive evidence that a given stain is blood unless he has obtained the several spectra (and particularly the deoxidized hæmatin spectrum) characteristic of it.

It may be asked, Do no other substances give similar spectra to those of blood? Of the *oxidized* hæmoglobin spectrum, Sorby says: "I do not know of anything that gives exactly the same, but there are some things which give bands so far similar as to show the importance of studying the effects of different reagents." This statement, coming from so great an authority, needs consideration.

The coloring matter (a form of chlorophyll) from the petals of the red variety of *Cineraria* gives two bands, which, though dissimilar in relative width, are nearly alike in position to those of oxidized hæmoglobin. But with ammonia, the bands of blood remain unchanged, whilst those of the *Cineraria* coloring matter are completely altered.

The other reds likely to be confounded by the unpractised eye

(certainly not by the practised eye) with blood, are *cochineal*, *lac-dye*, *alkanet*, *madder*, and *munjeet*, dissolved in each case in alum. But if the spectra produced by these bodies be carefully examined side by side with blood, the bands, it will be seen, are neither the same in position nor in character. None of them, further, will stand the action of ammonia, whilst they are all bleached with potassic sulphite, which has no action on blood.

All the supposed fallacies, however, at once break down if the various blood spectra with the several reagents described, can be obtained.

2. *Was the blood human ?*

And to this question it is better, in the present state of science, at once to confess our inability to give a definite reply.

The most ambitious attempt in this direction is that of Professor Richardson, of Pennsylvania (see "*Lancet*," 1874, II., p. 210 ; 1875, I., pp. 321, 700), who relies on the diameters of the blood discs, using for their examination very high microscopic powers, such as the $\frac{1}{25}$th or $\frac{1}{50}$th of an inch. Most interesting as his work is, it is as yet of scientific, rather than of practical importance. Even Dr. Richardson, regarding his own researches, himself admits: "That at present (1875) there is no method known to science for discriminating, microscopically or otherwise, the dried blood of a human being from that of a dog, monkey, rabbit, musk-rat, elephant, lion, whale, seal, or in fact any animal whose corpuscles measure more than $\frac{1}{4000}$th inch diameter."

One other suggestion deserves consideration, viz., the varieties in what have been called *Blood pictures*. "If the fluid blood, or dried blood redissolved in distilled water, be put on a piece of glass and carefully evaporated at a temperature of from 54° to 59° F. (12.2° to 15° C.), there will be received from the blood, either of man or animals under the microscope, entirely different pictures, which are in relation to each other of such great and striking variety, that human blood can be distinguished with the greatest exactness from the blood of animals, and the blood of one animal from that of another" (*A. Neumann*). Neumann's meaning (if I understand him aright) is, that the proportions of the corpuscles, of the fibrin, and of the salts in different bloods vary. When heat is applied to the blood, the corpuscles burst, their contents along with the fibrin and salts remaining on the glass plate. The variety in the "pictures" thus produced depends on the quantity of the corpuscles, and on the manner in which the salts and fibrin settle. Dr. Day apparently confirms these observations of Neumann. The results are curious and merit more attention than they have at present received.

3. *From what part of the body was the blood derived?*

To this question we must, as a rule, admit the practical impossibility of obtaining data on which to found an answer with any certainty. The only possible clue might be in the matters associated with the blood, such as the different forms of epithelium, etc.

4. *In the case of a blood stain being found on the clothes of a female, the question may arise whether or not the blood was menstrual?*

We urge the necessity for great caution in attempting to distinguish menstrual from ordinary blood. It has been stated—

(α.) That menstrual blood contains no fibrin.

(β.) That menstrual blood is acid, owing to its admixture with vaginal mucus; and,

(γ.) That menstrual blood is invariably associated with the pavement epithelium derived from the vaginal walls.

This last peculiarity is the only one of any practical importance, and admitting its truth, we doubt if in the present state of science we should be justified in venturing a *positive* opinion as to a stain being, or not being, menstrual from this circumstance alone.

5. *Was the blood derived from a living or from a dead body?*

The presence of coagulated fibrin in a stain is at all times strongly suggestive of the blood having been derived either from a living person or from a body within a short time after death; but even this is by no means an absolutely certain test. It is better to admit the impossibility of answering this question positively, although, should coagulated fibrin be found on the stained portion, it may be stated that there is a clear presumption that the blood was derived either from a living person or from one recently dead. (*Case* 78.)

6. *What is the probable age of the stain?*

On this point there is a great deal to be said. I have already mentioned certain well-marked indications of the age of a stain, viz.:—its color and solubility in cold water—in other words the chemical condition of the coloring matter, *i.e.* whether it be hæmoglobin, methæmoglobin, or hæmatin. I have for a long time past been engaged in an extensive series of experiments for the purpose of determining the time required for the change of hæmoglobin into methæmoglobin and finally into hæmatin at different places and under different conditions. The details of these experiments will be published elsewhere, but to my mind they justify certain conclusions of importance, which may be thus summarized:—

(α.) That the conversion of hæmoglobin into methæmoglobin may take place within an hour in a room lighted with gas, or within

twenty-four hours in the atmosphere of a populous town, or within four days by the seaside and for a few miles inland, whilst the change may be delayed for two, three, or even six weeks if the stain be merely exposed to pure country air free from all acid vapors.

(β.) That given a stain where unchanged hæmoglobin exists, it being proved that the stained body had been exposed to the atmosphere of a town (more especially if in a neighborhood where manufactures are in operation), we should be safe in saying that the stain might only be a few hours, but that, at the outside, it was not more than two or three days old.

(γ.) That, given a stain on a fabric where the hæmoglobin remains unaltered, it being proved that the stained article had been exposed to pure country air only, we should be safe in saying that the stain, at the outside, was not more than six weeks old.

But we desire to add that in answering this question the greatest possible caution is needed. One step beyond the region of absolute and well-attested fact should, as a matter of evidence, be regarded by the medical jurist as unknown and untrodden territory.

Seminal Stains.

In examining seminal stains we have to consider: (1) Their general appearance; (2) The action of heat; (3) Their chemical reactions; and (4) The microscopic detection of the spermatozoa.

1. *General appearance.*—A seminal stain is stiff and colorless. When seen by transmitted light, it presents a more distinctly greyish-brown tinge than stains produced by gum or albumen, with either of which it might be confounded.

2. *Action of heat.*—When a seminal stain is warmed, it becomes of a pale yellow tint. This constitutes a very characteristic reaction, happening with hardly any other discharge, healthy or morbid.

When warmed, or even when moistened with warm water, the stain evolves the odor peculiar to the seminal fluid.

3. *Chemical reactions.*—Cut out a small portion of the stained fabric. If the suspected stain be upon wood or stone, the material should be carefully scraped.

(α.) Digest a portion of the fabric (or scrapings) in a watch-glass with a few drops of water for about ten minutes. Remove the fabric, and carefully squeeze out with the fingers the water absorbed. Place the glass in a good light on a piece of white paper, and add to the solution a drop of nitric acid on a glass rod. If the stain be semi-

nal, the liquid will turn of a yellow color, but there will be no precipitate.

(β.) Lassaigne suggests that, in order to distinguish between an albuminous and a seminal stain, it should be moistened with a solution of lead oxide in liquor potassæ, and dried at 68° F. If it be albuminous (that is, if it contains sulphur), it turns of a yellow color, but if it be seminal, no change will be apparent, unless, as sometimes happens, the semen be diluted with an albuminous secretion.

(γ.) In pure seminal stains the guaiacum test gives no blue reaction. (Page 191.)

The above tests, however, are rendered practically worthless if the garment on which the stains occur be dirty or colored. Under such circumstances we must rely entirely on the microscopic examination. And it is to be further noted that we should in no case be justified in pronouncing a stain to be seminal, unless the results of the microscopic examination were conclusive.

4. *Microscopic Examination.*

This consists in the search for the characteristic seminal animalcules (spermatozoa, zoosperms). Admitting, as Casper proved, that semen may be found without spermatozoa, we consider there are no known data justifying a positive opinion that a given stain is seminal unless we are able to detect them.

In examining a Suspected Seminal Stain, carefully, and with as little handling as possible, cut out the stained portion. Place it in a perfectly clean watch-glass, with two or three drops (at most) of cold distilled water. Move the stained fabric about in the water with a glass rod. Having allowed it to soak for about ten minutes, squeeze out the water with the end of the glass rod, and examine several specimens of the liquid and of the deposits, under a quarter-inch power.

Another process has been suggested, which we believe to be of value. The suspected stain is to be steeped for 36 to 48 hours in an ammoniacal solution of carmine. The fibres of the fabric are then to be unravelled, each fibre being examined separately in glycerine under the microscope (500 diameters). The advantage claimed for this process is that vegetable fibrillæ are not tinted by the carmine solution, whilst the heads of the spermatozoa become of a full red color. This process is more particularly valuable where the stains are old and the spermatozoa adhere tenaciously (as is often the case) to the fibres of the material. (See *Report of Dr. Longuet to the Société de Méd. Leg., Paris.*)

The human spermatozoon has a flattened and almost oval head,

with a long, slender, filamentous tail. The entire length varies, according to Mr. Curling, from the $\frac{1}{500}$th to the $\frac{1}{600}$th of an inch. Some, however, are to be found that do not exceed the $\frac{1}{1000}$th of an inch. The tail is usually five or six times the length of the head, which is about $\frac{1}{9000}$th of an inch in diameter, and may roughly be regarded as about one-third the size of a human red blood-corpuscle. Tailless spermatozoa have also been described. (*Dr. H. Gibbes*, "*Quart. Journ. of Micros. Science*," July, 1880.) Their shape varies in different animals.

In fresh semen, and very frequently in semen for some hours after emission, as well as in that taken from a body some time after death, the vibratile, undulating movements of the animalcules, principally executed with the tail, betoken life. A case is on record ("*Beale's Archives*") in which active spermatozoa were found in the mucus taken from the vagina of a little girl fourteen days after she had been raped. But even after the spermatozoa are dead, and the stain dry, they may be easily distinguished by their peculiar shape. We have more than once seen them in stains six months old: whilst some have asserted they have been able to discover them after five or six years (*Ritter and Bayard*). They have certainly a remarkable power of resisting putrefaction, having been observed by several microscopists in semen after it had become putrid. Their movements, when alive, are not checked by admixture with other secretions. Their activity is stimulated by alkalies, but arrested by weak acids. A temperature above 120° F., however, kills them in a very short time.

With what may these Seminal Animalcules be confounded?

(1.) *Minute fragments of linen fibre* might be mistaken for the tails, and the *minute ovoid granulations* present in vegetable fibrillæ for the heads of spermatozoa. Hence it is a safe rule: *admit nothing to be seminal, unless some complete spermatozoa can be detected.* On the other hand, the presence of complete spermatozoa is to be regarded as unquestionable proof of the seminal nature of a stain.

(2.) *Granules* are to be found in all semen, that might be mistaken for the heads of the animalcules. These granules, however, are of considerable size. The rule we have just laid down will prevent any error arising from this cause.

(3.) M. Donné discovered and described an animalcule, not unfrequently found in the vaginal mucus of patients where cleanliness is not observed, called by him "*Trichomonas Vaginæ.*"

The microscopic differences between these trichomonads and the seminal animalcules are very definite:—

(α.) The heads of the trichomonads are at least three times the size of the heads of spermatozoa.

(β.) Internally the trichomonads appear to be granular, whereas the spermatozoa are transparent and structureless.

(γ.) From the head of the trichomonad several ciliæ are apparent, whilst none are visible from the spermatozoon.

(4.) Certain *fungi* are said closely to resemble spermatozoa, but their tails are clumsier, and they refract light differently. They may also be seen, under favorable conditions, to grow on the glass slide.

The following stains derive their chief medico-legal interest from the fact that they are liable to be mistaken for blood. Independently, however, of this they may also prove important as connecting links between a prisoner and the crime with which he is charged. For both these reasons they deserve attention.

Grease Stains.—The use of a pocket-lens will usually distinguish these from blood stains, with which, more especially on dark fabrics, they are likely to be confounded. Their nature may be easily determined by putting a piece of white blotting-paper over the stain, and pressing a hot iron upon it, when the grease stain will more or less completely disappear. They are also known by their ready solubility in ether, benzene, and chloroform.

Tar and Pitch Stains.—These may be known by their color, also by the peculiar and distinctive odor they emit when warmed. They are also readily soluble in turpentine and in alcohol, neither of which solvents have much effect on blood stains.

Tobacco Stains.—These, when warmed, emit a strong nicotine odor.

Iron Moulds, or Red Paint made from Iron.—These are insoluble in cold water, but soluble in hydrochloric acid. (Care must be taken that the acid used is itself free from iron.) The acid solution gives a dark blue with *potassic ferrocyanide*, and a bright red with *potassic sulphocyanide* provided there be no excess of acid. In cases where a stain is believed to be due to an iron-mould, the dye of the fabric should, in the first instance, be examined for iron.

Rust Spots on Steel Instruments.—Treat the spot with pure distilled water (avoiding the use of all acids) and filter. The water will remain uncolored, the rust spot being insoluble. If there be any precipitate on the filter-paper, it will probably be soluble in dilute hydrochloric acid.

Spots of Lemon or of Orange Juice on Steel.—In this case a citrate of iron is formed, which is soluble in cold water, the solution being of a light yellow color, and having an acid reaction. The tint is unchanged either by the action of ammonia or by boiling. It may be proved to be an iron salt by the general tests for iron.

Madder.—The color of madder is not destroyed by heat, whereas that of blood is. On adding a solution of alum, it turns yellow, whereas the red color of a blood-solution would merely be rendered more dilute.

Sanguinaria.—The red color is destroyed by ammonia.

Brazil Wood.—The red color is turned crimson by ammonia.

Logwood.—The solution is reddened by sulphuric acid, and blackened by iron sulphate.

Camwood and Red Saunders.—These colors are insoluble in cold water, but very soluble in alcohol and ether. They are both turned crimson by ammonia.

Archil, fruit stains, flower stains, etc.—These vegetable colors are for the great part turned either blue or green by the action of ammonia.

Anatto.—The color of anatto is soluble in water, and is not altered by the action of ammonia. It turns a dark blue tint on the addition of sulphuric or of nitric acid.

Catechu (*Cutch*), *Rhatany, and Kino.*—These bodies are soluble in water, but are not altered by the action of ammonia. The first two become black, and the third a greenish black, on the addition of a salt of iron.

XIII. Handwriting.—Variety of Inks.

It is seldom that medical men are called upon professionally to give evidence as to handwriting, experts or the cashiers of banks, or intimate friends or relations being generally summoned for this purpose. Occasionally, however, if forgery or erasure be suspected, the scientific chemist may be consulted, whilst the variety of ink used in a certain document and its similarity to the ink found in the possession of a prisoner, has on more than one occasion furnished important evidence of identity.

Sympathetic Inks.—A great many sympathetic or invisible inks have been from time to time suggested. Some of these are indicated in the following table:—

Ink.	Developer.	Color.
Solution of galls.	Dilute solution of an iron salt.	Dark brown or black.
Dilute solution of ferrocyanide of potassium.	As above.	Rich blue.
Chloride of cobalt.	Heat.	Blue. Color evanescent, but can be restored by reheating.
Mixed chlorides of cobalt and nickel.	Heat.	Green. Color evanescent, but again appears with heat.
Dilute solutions of gold and silver salts.	Exposure to light or heat.	Brownish black or purple tint.

WRITING INKS.—*Black Inks.*—Nearly all the black writing inks in common use contain gallate or tannate of iron, held in suspension by gum. Cloves, carbolic acid, and other antiseptics, are employed to prevent it from becoming mouldy. The following table from Watts' "*Dictionary of Chemistry*" shows the composition of various inks:—

Ingredients per 1,000 parts.	*a*	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*	*l*	*m*
Galls	225	187	133	125	66	62	31	50	174	50	60	42	33
Green vitriol	75	73	55	24	22	31	19	32	87	16	20	21	11
Gum	25	73	55	24	19	31	8	9	43	47	20	16	11.5
Logwood	...	...	...	...	..	..	..	...	...	100	20	21	33
Vinegar	...	...	...	...	..	..	..	125	135	...	..	..	...
Sugar	...	...	...	...	..	..	..	...	...	23	10	16	...

The sugar in *j*, *k*, and *l* admits of a copy being taken by pressing a moistened sheet of paper upon the writing (copying inks).

The so-called Alizarin inks contain a little free acid, and generally some sulphate of indigo. Such inks become very black by exposure to ammoniacal fumes. Extract of logwood mixed with potassic chromate makes a good black ink, which does not mould. It is, however, apt to get viscid and gelatinous.

Nearly all the inks mentioned may be removed by chlorine, or by a solution of oxalic acid, or by dilute hydrochloric acid. If Indian ink be added to them this possibility of removal is prevented. Traill's indelible ink is prepared by dissolving wheat gluten in vinegar, after steeping it for 24 to 36 hours in water, and rubbing up the resulting fluid with Indian ink or lamp-black. Another indelible ink is formed by mixing a *decoction of galls with vanadate of ammonium.* Chlorine

destroys the black color, but does not remove the ink. Acids turn it blue. Some of the *silver* inks (permanent marking inks) are almost indelible, but cyanide of potassium dissolves them.

An aniline black ink and other aniline inks are now often used.

Blue Inks.—Composition: Prussian blue, 30 parts; oxalic acid, 4 parts; water, 1,000 parts. Another variety of blue ink contains: Prussian blue, 12.5 parts; oxalic acid, 25 parts; water, 1,000.

Red Inks.—1 part of good carmine dissolved in 120 parts of strong ammonia, with 1.5 part of gum Arabic. A cheaper form consists of 12 parts of powdered cochineal, 4 parts of ammonic carbonate, and 32 parts of hot water. Digest and decant. A third variety is prepared by boiling together to one-half 2 lbs. of Brazil wood, 1½ lb. of Rupel or Roch alum, and 2 gallons of good vinegar.

Yellow and Green Inks.—The former is a decoction of saffron, and the latter a solution of indigo-carmine mixed with picric acid.

Printers' Ink.—This is a mixture of boiled linseed-oil, yellow soap, drying ingredients, and lamp-black.

Vermilion, ultramarine, and lead-chromate respectively, are used for red, blue, and yellow printers' inks, instead of lamp-black.

Erasures.—Before making any experiments with or manipulating paper on which an erasure is suspected, it is well to have it photographed. The character of the paper (noting whether it be hand or machine made, and whether it be glazed on the surface only or all through) deserves careful study. The water-marks of the paper and its texture, which latter is best demonstrated by the microscope, have often proved highly important. The paper should now be minutely examined with a lens, and any peculiarities of character or of surface recorded. Any variations in the translucency or transparency of different parts should be accurately noted. Again, it is often a good plan to wet the paper, placing it for this purpose on a glass plate, to note whether the water is more greedily absorbed at the spot of the supposed erasure than elsewhere. The use of paraffin, turpentine, benzol, etc., for this purpose, instead of water, have been recommended when the paper is very thick.

Forgers not unfrequently gum, varnish, or glaze the spot that they have scraped or erased. Size and other animal gelatines used for this purpose may be known by turning brown when treated with a weak iodine solution, and starch by its turning blue. Gum is soluble in water, but is precipitated from the solution on the addition of alcohol. Resinoid bodies are soluble in alcohol, but are re-precipitated by water.

In the vast majority of instances where an erasure has been at-

tempted, the application of a solution of galls will at once reveal the remains of the iron of the original writing-ink. It is frequently of use, before applying the galls, carefully to pencil over the erasure a weak solution of ammonia. Sometimes the application of a ferrocyanide of potassium solution gives good results, bringing out strongly the blue color of iron-inks, but in such case no ammonia should be used.

When chlorine or solutions of the hypochlorites have been freely applied to paper on which there has been writing, the color of almost all inks, excepting those that contain carbonaceous matter will be destroyed.

If an acid has been used to remove the ink, its presence may be detected by the use of litmus, unless an alkali has been afterward employed to neutralize it. Papers tinted with ultramarine are so changed in color by the action of acids, that they are not very likely in such case to be used for purposes of erasure, but if the paper be colored with smalt or Berlin blue, it admits of acids being used as bleaching agents. The use of an ammonia solution as a means of detecting erasures, is most applicable to iron-inks that have been bleached by acids.

XIV. The Limits of Sight, and Questions relating to Vision.

What are the limits of healthy Sight unassisted by Instruments?

The shape of the earth sets a certain limit to vision, even as regards very large and lofty objects. This will be seen by the following table taken from Carr's "*Synopsis of Practical Philosophy.*"

Table showing the distance in miles of the farthest visible point that can be seen from the top of a given height, taking into account the effects of refraction.

Height in feet.	Distance in miles.	Height in feet.	Distance in miles.	Height in feet.	Distance in miles.	Height in feet.	Distance in miles.
5	2.96	60	10.25	500	29.5	5,000	94.0
10	4.18	70	11.1	700	30.5	6,000	102.0
15	5.12	100	13.2	1,000	41.8	7,000	110.0
20	5.91	150	16.2	1,500	51.0	8,000	118.0
25	6.61	200	18.7	2,000	59.0	9,000	125.0
30	7.25	250	20.9	2,500	66.0	10,000	132.0
40	8.37	300	22.9	3,000	72.0	15,000	162.0
50	9.35	400	26.4	4,000	83.0	20,000	187.0

It follows from this, that a man of ordinary height can be seen on level ground at a distance of about three and a half miles on a clear day.

In the case of hypermetropic, myopic, and presbyopic persons, or of patients with other varieties of imperfect sight, lenses are needed, or allowance must be made.

We here speak merely of *sight*. This is vastly different from recognition in order to secure personal identity.

The following conditions must be present for the recognition of an object at the distances stated:—(1.) Normal vision. (If abnormalities of vision exist, these must be compensated.) (2.) Sufficient light. (3.) Sufficient size of object.

1. *Normal Vision.*—This consists in the sight of both eyes being perfect. The loss of one eye can scarcely be called "*deprivation of sight*," but it certainly is "*deprivation of normal sight.*"

Again, the eyes must be normal in their power of discerning color. *Color-blindness*, or *Daltonism*, has been the cause of many railway accidents, owing to colored lights or signals not being recognized. Even in war a red uniform has been confounded with a gray, and thus friends have been fired upon as if they had been foes, and foes allowed to escape as though they were friends.

A valuable contribution to our knowledge of color-blindness has been made by Dr. de Fontenay, of Copenhagen ("*Nordiskt Medicinískt Arkiv*," 1880). He follows the classification proposed by Holmgren:—1. Total color-blindness. 2. Partial color-blindness: (*a*) Complete blindness of red, green, or violet; (*b*) incomplete color-blindness; (*c*) feeble sense of color. The last (*c*) is not Daltonism properly so called, and is omitted in the statistics. The examinations were made by means of Holmgren's colored wools, and in some of the cases in which color-blindness was detected, the results were controlled by various additional tests.

The total number of persons examined was 9,659, of all ages from eight years upward; 6,945 being above the age of sixteen, and 2,714 below that age. Of the whole number, 217, or 2.25 per cent., were color-blind. Of 4,492 adult males, 165, or 3.7 per cent., had color-blindness. Among these, 1,001 belonged to the upper classes, and showed a percentage of 3.09; while in 3,491 artisans, laborers, etc., the percentage was 3.87.

Occupation.—The percentages of color-blindness varied greatly with the *employment of the individual.* Thus of 2,737 railway officials, 3 per cent. were color-blind; of 183 post-office officials, 9.28 per cent.; of 930 artisans of various kinds, 3.22 per cent. It is not cer-

tain how far these proportions are accidental, or how far the greater prevalence of color-blindness in the lower orders may be due to defective cultivation of the sense of color, or to heredity. In any case, Dr. de Fontenay's observations agree with those of Holmgren, Magnus, and others.

Age and Sex.—Of 6,945 adults above the age of sixteen (4,492 males and 2,453 females), 176 or 2.56 per cent., were found to be color-blind. Among the females, there were only 11 cases of color-blindness, or 0.45 per cent. Adding to these the female children who were examined, a total is obtained of 3,819, among whom there were 16 color-blind individuals, or 0.42 per cent.; while, in a total of 5,840 males (adults and children), the number of cases of Daltonism was 201, or 3.44 per cent. All the sixteen color-blind females belonged to the working classes. Among the 2,714 children, aged from eight to sixteen, 41 or 1.51 per cent. were color-blind—viz., 1,348 boys, with 36 color-blind, or 2.67 per cent.; and 1,366 girls with 5 color-blind, or 0.37 per cent.

Varieties of Color-blindness.—Two cases of violet-blindness which were incompletely examined being excluded, there were found to be 56 cases of red-blindness, 24 of green-blindness, and 135 of incomplete color-blindness. In all the cases, both eyes were examined separately, and found to be affected. As regards the relation between the color of the eyes and color-blindness, Dr. de Fontenay does not find any special predominance in dark or in fair individuals.

Heredity.—With regard to the hereditary transmission of color-blindness, exact information was obtained in 34 cases, in 27 of which heredity was denied. In two of the remaining cases, the fathers were color-blind in the same way as the subjects examined. The parents of another had normal vision; but a paternal uncle, two brothers, and the son of the person examined were color-blind. In the parents and grandparents, and in the son of another person, the color-sense was normal; but his brother and three maternal uncles had color-blindness. In another case, the perception of colors was normal in the father, mother, brothers, and sisters; but the maternal grandfather, a maternal cousin (male), and the son of a female cousin on the mother's side, were the subjects of Daltonism. Another of the color-blind persons had four relatives who were similarly affected, viz., a maternal uncle and cousin, his mother's grandfather, and a brother. There was no instance of consanguineous marriage among Dr. de Fontenay's cases of color-blindness.

Dr. de Fontenay says that the increased attention paid to color-blindness within the last few years, has been attended in Denmark

with some important results. All the *employés* of the public (State) and private railways have been examined, in order to ascertain their sense of color (except in the case of one private company, which did not think such an examination necessary); and henceforth all candidates for situations on railways are to be tested. Candidates for admission to the school of naval officers also submit to an examination.

Herr E. J. Mellberg, principal teacher of physics in the Lyceum at Helsingfors, has also examined the color-sense of the 227 pupils in that institution. Among them, he found ten cases of Daltonism, or 4.4 per cent.; four of red-blindness, two of violet-blindness, and three of incomplete color-blindness. In addition, among the boys whose sense of color was stated to be normal, there were three who confounded light yellowish-red with rose-color; eighteen who could not distinguish between bluish-green and pure green; fourteen who failed in both these respects; and nine in whom the perception of colors was weak. The age of the subjects varied from nine to twenty, but only one case of color-blindness was met with in those above the age of seventeen.

The *effects of age* on the acuteness of vision is considered by Dr. de Guéret to be, on an average, as follows:—

The acuteness of vision at	50 years	is diminished	$\frac{1}{5}$ [1]
"	60	"	$\frac{1}{4}$
"	70	"	$\frac{1}{3}$
"	80	"	$\frac{1}{2}$

In other words, if a man of forty could distinguish and recognize an object at 100 feet distance, at sixty years of age he could not recognize the same object further off than 75 feet. It would be interesting to know precisely how these results were obtained, and whether care was taken to exclude all cases of incipient cataract.

2. *Sufficient Light.* (α.) *Moonlight.*—The best known person cannot be recognized by the clearest moonlight at a greater distance than 15 to 16 metres (16 to 17 yards). The light of the moon, however, is very variable, whilst on a bright night the shadows produced are often intense, well-defined, and lengthy.

(β.) *Starlight.*—By starlight only, the best known person cannot be identified further off than 3 to 4 metres (10 to 13 feet). [1]

(γ.) *Flash of Lightning* (*Case* 72).—The light emitted from a flash of lightning is said to have sufficed to enable a lady, on her passage

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[1] See also "*De l'acuité de la vue pour les grandes distances,*" par le Dr. J. Gayet; "*Annales d'oculistique,*" Sept.-Oct., 1875, p. 171.

home from India, to see distinctly, and afterward identify, a man robbing her trunk in the cabin of a vessel on a dark night. (Montgomery, "*Cyclopædia of Practical Medicine*," art. Identity, quoted by Guy.) The author has experimented many times on this point, and entirely agrees that a flash of lightning is in *many cases*, but by no means in all, amply sufficient for purposes of identification. Thus, he was able on one occasion to detect a black hair-pin on the ground by a flash of lightning, and to pick it up when the next flash came.

(δ.) *Flash of Firearms.*—It may be asked:—"Is the light resulting from the flash of a pistol or gun sufficient to enable one to see clearly the face of the person firing?" In May, 1808, the Sieur Labbé was riding, accompanied by the widow Beaujean, along the high road, one hour and forty-three minutes before the rising of the moon, when the servant of the former was wounded in the hand by a gun fired through a hedge. Both swore that they recognized the assassin by the light of the discharge. (*See* Guy, p. 7, and Taylor, *Med. Juris.*, I., p. 684.) The accused, being sentenced to death on this evidence, appealed to the Court of Cassation, and many experiments were made by Guineau, Dupuis, Caussin, and others, which seemed to negative this possibility. In their own words: "The light was so fuliginous and so transient that it was scarcely possible to see distinctly the form of a head, and that of the face could not be recognized." The sentence was reversed. Foderé afterward contested this decision, and a subsequent case, confirmed by the experiments of Desgranges, of Lyons, showed the possibility of such recognition.

In England, similar evidence has been received in several cases. In one case (*R.* v. *White*, Croydon Autumn Assizes, 1839), the accused was acquitted. In a second (*R.* v. *Stapley*, Lewes Lent Assizes, 1862), the evidence of a game-keeper, who identified his assailant by the flash of the gun, was received, and the prisoner convicted. In Paris and Fonblanque's case in 1799 (*R.* v. *Haines*), a police officer deposed that the highwayman rode a dark-brown horse of remarkable head and shoulders, and wore a rough brown great-coat. These statements were received as satisfactory, though they were made out entirely by the light emitted by the flash from his pistol. He stated that he had since identified the horse in a stable in London.

M. Cauvet (Constantinople), who has lately investigated this point (Dec., 1873), concludes:—(1.) That recognition of a person firing is possible if the observer be within five paces of the discharge and at the side of the line of fire; or (2.) If the discharge occurred in a close place of small dimensions, and the observer occupied a stooping posture. (3.) Recognition is affected by the quality of the powder used,

the best English powder being that from the explosion of which recognition is the most certain.

Our own experiments on this point lead us to believe in the possibility of recognition in the majority of cases, that is, given a moderate distance, a dark night, and the absence of any artificial light, and that the smoke produced by the explosion is not great. Given the reverse of these conditions, viz., a considerable distance, a weak flash, and much smoke, and we are of opinion that the chances of identification would be doubtful.

Dr. Taylor also agrees in the possibility of recognition under such circumstances.

(ε.) "*Seeing Sparks.*"—The possibility of recognizing an assailant by the subjective sensation of flashes of light (vulgarly called "seeing sparks") produced by a blow on the eyeball is not worth serious discussion. (Müller's "*Physiology*;" Schilbach and Krügelstein in Henke's "*Zeitschrift der S. A.*," 1842, I., 197, and 1845, III., 172.) Such sensations are not uncommonly felt by those who are totally blind.

We are astonished that medical jurists should have deemed this matter worthy of notice.

3. *Sufficient Size of Object.*—With respect to the smallest objects recognizable by the unassisted sight, there has been much difference of opinion. Carpenter states (apparently on the authority of Ehrenberg) that the smallest square magnitude, black or white, which can be seen on a ground of the reverse color, is about the $\frac{1}{400}$th to the $\frac{1}{540}$th of an inch, whilst particles that powerfully reflect light, such as gold dust of the $\frac{1}{1125}$th of an inch, can be seen with the naked eye in common daylight. Bergmann found that black and white chequers of $\frac{1}{25}$th of an inch square could be discerned at such a distance that the retinal image of each square could not have exceeded half the diameter of one of the cones of the bacillary layer, which are said to have a diameter of $\frac{1}{4166}$th of an inch. Dr. Vincent de Guéret (of Creuse) in "*La France Médicale*" (No. 57, for 1875), states that objects to be seen at all must have a diameter of the $\frac{1}{6250}$th of an inch.

Lines are more easily perceived than *points*. Thus opaque threads of the $\frac{1}{4000}$th of an inch (*i.e.*, about half the diameter of a silk-worm's fibre) can be discerned by most people with the naked eye when held toward the light. Volkmann (quoted in Funke's "*Lehrbuch d. Physiologie*") considered that parallel black lines could be seen when only the $\frac{4}{1000}$th of a millimetre apart (= $\frac{1}{6250}$th of an inch).

Passing from microscopic objects, we note that at a distance of one *foot a person* with normal sight can scarcely see an object less than

the $\frac{1}{25}$th of an inch. At greater distances the size must increase comparatively.

The recognition of individuals depends on various points. The features, the color and arrangement of the hair, prognathism, the color of the eyes, etc., in the case of people comparatively near, are the important means of identification; whilst beyond a certain distance, stature, gait, and general peculiarities, such as unusual actions, etc., are no doubt the primary means by which we know one person from another. Naturally, therefore, the more marked the peculiarities of the individual, the more easily he may be recognized at a distance.

From experiments on recognition, Guéret concludes that the best-known persons, even those possessing well-marked personal peculiarities, can only be recognized, and that with difficulty, in broad daylight at a distance of 100 metres (a little over 109 yards). Beyond 150 metres (164 yards) he believes recognition to be perfectly impossible. Less known and less remarkable people can only be recognized in broad daylight at a distance of from 60 to 100 metres (65 to 109 yards). In the case of people who have no personal peculiarities, and are almost strangers, he regards 25 to 30 metres (27 to 33 yards) as about the limit for recognition.

XV. The Velocity of Sound.—The Distance at which Sounds are Audible.—Limits of Hearing.

There are a few questions relating to sound that may possess a certain medico-legal importance:—

1. *Velocity.*—The velocity of sound in air is 1,090 feet per second at 32° F. (0° C.). At lower temperatures the velocity is less, and at higher temperatures greater. It may be taken that the velocity increases about 2 feet for every 1° Cent.

The velocity of sound depends on the elasticity of the air in relation to its density, it being *directly* proportional to the square root of the elasticity, but *inversely* proportional to the square root of the density. The law of Marriotte proves that in air density and elasticity vary in the same proportion. Hence density neutralizes elasticity, and consequently the velocity of sound in air becomes independent of density. But for this law to hold good, the dense air and the rare air must have the same temperature. This fact may be important. Given, the *same temperature* at the top of a high mountain and in the valley, the velocity of a sound (say, of a pistol-shot) would be alike in both; but, given a *lower temperature* at the top of the mountain

(which is usual) than in the valley, and the velocity of the sound on the mountain would be less than in the valley.

In water the velocity of sound is four times, and in iron seventeen times greater than in air. In wood the velocity will depend on the variety and on the direction of the fibres, there being marked differences in different directions of grain.

2. *Intensity.*—At great elevations the loudness of a given sound suffers sensible diminution. In *free* air, intensity diminishes as the square of the distance from the source of sound increases. Thus, the firing of a pistol would sound *four* times as loud to a person at 100 feet, as it would to a person 200 feet distant. This law, however, does not hold good when the sound wave is generated in a confined space, where lateral diffusion is limited, more particularly if the interior surface of such space be smooth.

Intensity depends, not on the density of the air in which the sound is heard, but on the density of the air in which the sound is generated. If of two sounds of like intensity the one be generated on a mountain and the second in a valley, the sound generated in the heavy valley air may be heard on the mountain, whilst that generated in the light mountain air might not be heard in the valley. Again, if a pistol be fired at a spot midway between the valley and the mountain top, the sound might reach an observer on the mountain and an observer in the valley with a similar intensity, although in one case it had to travel through the rarer mountain air, and in the other through the denser valley air.

3. *Limits of Hearing.*—With even the normal sense there are distinct limits to the power of hearing. Savart fixed these as between 8 complete vibrations per second and 24,000, whilst Helmholtz regards the limits as between 16 and 38,000, or 11 octaves. The practical limit, however, is between 40 and 4,000 vibrations per second, or a range of about 7 octaves. But different people have in this respect vastly different powers, some being able to recognize low sounds but not high, and others high sounds but not low.

Further, every individual has a certain power of altering his special limits of sound appreciation (more particularly for low sounds) by altering the tension of his tympanic membrane, either by forming a partial vacuum, or by compressing the air, in the cavity behind the tympanum. As an illustration, the sense of hearing low sounds may be almost entirely quenched by stopping the nose and mouth and expanding the chest as in the act of inspiration.

TABULAR STATEMENT OF THE DETAILS TO BE OBSERVED AND NOTED IN THE EXAMINATION OF PERSONS, OR OF BODIES, OR OF BONES, RE IDENTITY.

I. General.

1. *The surroundings of the body.*
   Note—(α.) Clothes.
   (β.) Jewelry.
   (γ.) All articles found on the body or in the coffin.
   (δ.) Hairs grasped in the hands or free about the body.

2. *The probable business or trade at which the person worked.*
   Note—(α.) Condition of the hands (horny or soft).
   (β.) Any special injuries to nails.
   (γ.) Any special stains (such as silver and dye stains).

3. *The height of the person.*

4. *The weight of the person.*

5. *Age.*
   Note—(α.) The amount and color of the hair.
   (β.) The teeth.
   (γ.) The condition of the alveolar processes.
   (δ.) The condition of the fontanelles.
   (ε.) The points of ossification.
   (ζ.) The condition of the epiphyses.
   (η.) The size of the bones.

6. *Sex.*
   Note—(α.) The genital organs.
   (β.) The breasts.
   (γ.) The general conformation.
   (δ.) The length of the back hair and the nature of the hair generally.
   (ε.) The pelvis.
   (ζ.) The markings on the bones.

7. *Deformities.*
   Note—(α.) Shortening of legs from disease of hips, etc.
   (β.) Spinal disease.
   (γ.) Talipes.
   (δ.) Large wens.
   Etc.

8. *Marks, growths, etc., on the skin.*

Distinguish between those arising—

(a.) From *disease* (such, *e.g.*, as scrofulous ulcers, small-pox, diseased teeth, syphilis, skin diseases, etc.).

(β.) From *operations.* (Major operations. Also bleeding and cupping, leech-bites, setons, etc., etc.)

(γ.) From *tattooing or flogging.*

(δ.) From *natural causes.* (Discoloration; nævi; moles; warts.)

(ε.) From *violence.*

(ζ.) From *stains* (such as blood, etc.).

9. *Injuries.*

Note—(a.) Fractures.

(β.) Dislocations.

(γ.) Wounds. Consider—(1) their probable origin; (2) position; and (3) extent.

Etc.

Examine now in detail the various parts and organs of the body:—

10. *The Head.*

Note—(a.) Complexion. (Fair, dark, sallow.)

(β.) Shape and general type of face and head. (European, Mongolian, etc.)

(γ.) Forehead. (Low, high, prominent.)

(δ.) Eyes. (Large or small, sunk or prominent.)

(ε.) Nose. (Short or long, flat and broad, broad or well-formed nostrils, etc.)

(ζ.) Ears. (Lobules well formed or continuous with the cheeks:—pierced or not.)

(η.) Mouth. (Large or small; note scars on the roof:—the condition of alveolar processes.)

(θ.) Lips. (Large or small. Cicatrices.)

(ι.) Teeth.

Number.

Regularity.

State of decay.

Any special parts where they are more than usually worn.

Whether there are false teeth, or indications exist of their having been worn.

(κ.) Chin. (Full, round, double, pointed, or receding.)

(λ.) Hair.
Amount, color, and length of hair on head, lip, and chin.
Whether the color be natural. (Test if necessary.)
Whether it has been recently cut.

11. *The Neck.*
Note—Its characters. (Short or long:—thin or thick. Cicatrices.)

12. *The Chest.*
Note—(a.) Formation. (Well formed or pigeon shaped.)
(β.) Shoulders. (High or sloping.)
(γ.) Sternum. (Flat or sunk, etc.)

13. *The Pelvis.*
Note—(a.) The Genitals; normal or otherwise.
(β.) In females the question of pregnancy.
(γ.) In the case of a skeleton, decide whether the pelvis be that of a male or female?

14. *The Extremities.*
Note—(a.) The Arms. Size and length generally.
The Fingers, short or long.
Whether they are of proper proportional length.
Any peculiarities of the nails.
The Hands, roughened or not by hard work.
Whether marked or not by stains.
(β.) The Legs, whether uniform or not in length.
Anchylosis of joints.
Whether bowed or not.
Whether in-kneed.
The ankles and feet.

II. In the Case of Mutilated Remains.

In addition to what has been stated, note:—

1. *The degree of accuracy with which the parts fit together as follows:—*
(a.) Bones.
(β.) Muscles.
(γ.) Blood-vessels.

2. *The nature of the mutilation:—*
(a.) Whether the muscles are hacked, or have been divided by a sharp knife.
(β.) Whether the bones have been chopped or cut with a fine or coarse saw.

3. *The after-treatment to which the parts have been subjected :—*
   (α.) Whether they have been acted upon by lime or other chemicals.
   (β.) Burning.
   If the bones be entire examine as usual.
   If only an ash be found, examine this for phosphate of lime.
   (γ.) Boiling.

III. In the Case of the Discovery of a Skeleton or of Individual Bones.

In addition to the points already indicated, note :—

1. The extent to which the soft parts have disappeared.
2. The extent to which separation of the bones has taken place.
3. The color of the bones.
4. Their state of preservation.
5. Are they human or not?
6. The sex as determined from the pelvis and the characters of the bones generally.
7. Do the bones belong to one or to more than one body.
8. Carefully examine the pelvis and the parts around for the remains of fœtal bones.
9. Examine carefully for any evidence of disease of the bones. (Spinal disease, anchylosis, rickets, syphilis, softening, etc.)
10. Existence of injuries.

ILLUSTRATIVE CASES.

1. **R. v. Raynon.**—(*Taunton Spring Assizes*, 1841.)—Prisoner charged with wounding. A cut on the thumb of the prisoner, stated by him to be three weeks old, was proved by medical evidence not to have been inflicted longer than two or three days, a period that coincided with the time of the alleged assault. Prisoner convicted. (Pages 128, 157, 159.)

2. **R. v. Henry Reed and Eliz. Donelan.**—(*Chelmsford Spring Assizes*, 1842.)—In this case the prosecutrix accused the prisoners of inflicting a wound on her nose with a sharp instrument, causing profuse bleeding and a fracture of the bridge. The prisoners were convicted, no medical evidence being offered in defence. A short time after the trial, and within six months of the alleged assault, the prosecutrix was examined, and no scars were found. An eminent surgeon to whom the case was referred decided that no injury such as that described by the prosecutrix could have been inflicted, or a scar of some kind would most certainly have been visible. (Pages 128, 157, 158.)

3. **Smyth v. Smyth.**—(*Gloucester Summer Assizes*, 1853.)—The plaintiff, as a lost heir, claimed certain estates. The real heir, it was proved, had certain marks on his hand and wrist, caused at birth by instrumental delivery, and the claimant asserted that such marks in his case were visible. The case of the claimant broke down on other points, but it was evident that the marks on the hand and wrist exhibited by him were merely the puckered cicatrices of scrofulous ulcers, similar scars also existing on the neck. (Pages 128, 152, 157, 162.)

4. **R. v. Castro, alias Orton, etc.—The Tichborne Case.**—(See "Guy's Forensic Medicine," p. 686.)—A man, believed to be Arthur Orton, the son of a Wapping butcher, claimed to be Sir Roger Tichborne, and heir to the baronetcy and estates. Roger was believed to have perished at sea in 1854.

In this case much depended on the following facts:—

(*a.*) *Marks and Scars.*—(*a.*) The real Roger had had an issue in one arm that had been kept open a long time, and was almost certain to have left

an indelible scar. Some said he had also had a seton. The claimant had no corresponding mark. (*b.*) The real Roger had been bled frequently in both arms, in both ankles, and in one temple. There were no marks indicating bleedings on the claimant. (*c.*) There was evidence to show that the real Roger had been tattooed with Indian ink. There were no signs of tattoo marks on the claimant. (*d.*) The claimant had a brown mark on his side; but there was no evidence to show that the real Roger had a similar mark.

On the claimant a mark was found just above the left wrist, of the origin of which the claimant professed ignorance. The theory of the prosecution was that this was the mark of caustic used to efface the letters A. O. (Arthur Orton) once tattooed there.

(*β.*) In this remarkable case *the question of age* was not of much importance, there being a difference of only five years between the age of Orton and that of Roger.

(*γ.*) *Personal appearance* was an important element. Could Roger, who at 21 was slim, 5 feet 8½ inches high, and 9 stone in weight, having narrow hips, thin straight legs, and long bony fingers, become, after twelve years of active Australian life, the huge man the claimant was?

The *type of face* was important. Roger, it was proved, had a flat, broad nose with large nostrils, the central groove joining the nose to the upper lip being wide. The lobules of the ears were badly formed, and continuous with the face. His eyes also were blue, with long black lashes. The claimant had a straight aquiline nose with round end and well-formed nostrils, the central groove joining the nose to the upper lip being narrow. He had well marked lobes to his ears, and brown eyes and lashes.

Roger's brows, it was further proved, were wide apart, and the eyes tended *upward* from the nose. The claimant's brows were near together, and the eyes from the nose had a tendency *downward.*—(*Piercy.*)

(*δ.*) The claimant knew no French, whereas Roger knew French better than English. (Could Roger have entirely forgotten it after twelve years?) Further, the claimant had forgotten many facts very familiar to Roger, and claimed to remember many less striking facts. Thus he claimed to remember the name of a dog, but did not remember the Christian names of his mother.

The claimant was found guilty of imposture. (Pages 127, 128, 150, 157, 165.)

5. **Edin. Med. Journ., 1875, Vol. XXV., p. 391.**—(*Dr. Littlejohn.*) —Identification of the bodies of infants :—

(1.) Identification proved by means of a small blister the size of a pea, situated about a quarter of an inch from the semi-cicatrized umbilicus. This blister had attracted the attention of a nurse on the only occasion *that she* had dressed the child.

(2.) Identification proved by a patch of downy hair on the upper part of the child's sacrum.

(3.) Identification proved by the similarity existing between a piece of thread used to tie the umbilical cord of an infant, and certain thread found in possession of the mother.

(4.) Identification proved by the severed end of that part of the funis attached to the infant, fitting precisely to the corresponding portion attached to the afterbirth. (Pages 125, 152, 162.)

5a. Med. Times and Gaz., Aug. 19, 1871, p. 222.—In the gun-cotton explosion at Stowmarket the identity of one of the sufferers was clearly proved by a scar on the ankle. (Pages 128, 157.)

6. Douglas Peerage Case.—In this case family likeness was insisted upon and accepted as evidence of relationship. (Page 127.)

7. Foderé, Traité de Méd. Légale, Vol. I., chap. 2.—(From the Causes Célèbres before the Parliament of Toulouse, 1560. For details see Guy, p. 28, and Beck.) Martin Guerre had been away from home for eight years. An adventurer called Armand Dutille, who appears to have exhibited the closest possible resemblance in features and person to Guerre, passed himself off as Guerre, and was accepted by Guerre's wife as her husband. She had children by him, and he took possession of Guerre's property. He lived three years in the family, with four sisters and two brothers-in-law of Guerre's, without exciting their suspicions. At last, his claims were disputed. The matter came to trial, when the reappearance of the real Martin Guerre, and the full recognition of the true man by the brothers and sisters, led the judges to pronounce Dutille an impostor. Dutille had lived some years with Guerre, by which means he not only became conversant with many family secrets, but had received from Guerre, at a time when he thought he was on the point of death, several family relics. (Pages 124, 127.)

8. Foderé, Traité de Médicine Légale, ch. 2.—(*Zacchias.*)—Cassali left his country when young, and was supposed to have been killed in battle. He returned after an absence of thirty years, and claimed the property appropriated by his heirs. He was imprisoned as an impostor, but was afterward restored, chiefly on the opinion of Zacchias, that the changes stated to have occurred might have resulted from age, time, hardship, diet, disease, etc. Further, the relations could not prove the death of Cassali. (Pages 125, 126, 128, 151.)

9. Dover Standard, Dec. 25, 1875.—"On the morning of the 9th instant the body of a man, in a somewhat mangled condition, was discovered about half a mile distant from the Addison-road station, and two

days later was identified by a woman named Triggs, of Cumberland-place, Hammersmith, as that of her husband. Further identification was forthcoming also in the testimony of one of Mrs. Triggs' children, and of the supposed employer of the deceased man. An inquest was held at the Kensington Workhouse, and a certificate for burial granted by the coroner. Within an hour of the interment, and as the hearse was nearing the door of Mrs. Triggs, to the surprise of all parties the latch was lifted, and William Triggs, the husband supposed to be dead, entered the house, and gave a satisfactory account of his absence." (Pages 124, 127.)

10. **Case of Baronet.**—(Foderé "Traité de Méd. Légale," ch. ii.)—Baronet was born in 1717, in the diocese of Rheims, and left his home at the age of twenty-five to get his living as a domestic. He returned after twenty-two years' absence to claim a little property, the whole of which, however, his sister had spent. In order to meet this difficulty, she persuaded a neighbor, named Babillot, to claim her brother as his son. He did so at first, but afterward recanted. However, as his sister denied him, Baronet was sent to the galleys. After a few years, public opinion changed, and the Parliament of Paris was appealed to. Among others, Louis, the great surgeon, was consulted. He inclined to Baronet's side, and the man was restored to his liberty and legal rights. Amongst other differences, Baronet was sixty, Babillot being only forty-six, and the latter, according to the father of Babillot, had a nævus on his thigh, whilst Baronet had no such mark. (Pages 124, 126, 150, 153.)

11. **Annales d'Hygiene, Jan., 1847.**—A robber discovered by certain blood spots on the snow, traced from a house where a burglary had been committed. The blood marks were on the *left* side of the footprints. A portion of skin was found in the snow, corresponding to an injury on the *left* hand of the accused. The prisoner afterward confessed his guilt. (Pages 128, 155.)

12. **Indian Med. Gazette, Jan., 1875, p. 5.**—(*Dr. Meredith.*)—Male, æt. 9. Identity determined from a skull, five ribs, and five vertebræ. The teeth and the peculiar shape of the skull were the important data in this case. (Pages 131, 178.)

13. **R. v. Elizabeth Ross.**—(*C. C. C.*, 1831.)—Murder of Caroline Walsh.—(For details see "Taylor's Med. Juris.," Vol. I., p. 149.) The question in this case was one of identity. A certain woman (named Caroline *Walsh*) disappeared. It was believed that she had been "burked" for an anatomical school. The woman Ross was tried for the murder. On the same day that Walsh disappeared, a woman (named Caroline *Welsh*) was found in the street with her hip broken. The contention of the de-

fence was that Welsh was the woman Walsh that the prisoner was accused of murdering. It was proved that:—

Walsh came from Kilkenny, was 84 years of age, tall, of sallow complexion, having gray hair, and very perfect incisor teeth.

Welsh came from Waterford, was 60 years of age, tall, of dark complexion, and had no front teeth, the alveolar cavities having probably been absorbed for some time.

The prisoner was convicted. (Pages 126, 127, 181.)

14. **Ogston's Med. Juris., p. 66.**—A medical student of the name of Downie, who died about two years afterward, had, in company with some others, disinterred a body from the churchyard of Newhills. On the night after that of the disinterment, they were bringing it to town from a place where it had been temporarily concealed, near Donmouth. They had scarcely, however, moved from the spot when the Coastguard suddenly came upon them. Downie's companions fled, leaving him with the body, which he attempted to defend, but was overpowered and captured. The Coastguard brought the body to town with the prisoner, whom they lodged in gaol. A day or two after this the wife and sons of a weaver in the "Spital," who had been some days missing, came forward and claimed the body as that of their relative. But as this person had been in good health at the time of his disappearance, and as no reason was known for his absence, the relatives of the weaver, who had sworn most positively to the identity, accused Downie of having enticed him away and murdered him.

Downie, seeing the serious nature of the charge thus preferred against him, found it necessary to state where he had actually procured the body in question. A party was then sent out to Newhills, to search the grave there, which they found empty.

But here a new difficulty arose. The relatives of the Newhills dead person, when shown the body, offered to make oath to it, while the Spital people refused to acknowledge their mistake.

At this stage of the proceedings, however, the case assumed a new aspect. The Spital weaver reappeared in life, but so incredulous were the people of the neighborhood, that he had to be paraded through the streets to satisfy them, and many even then would scarcely believe the evidence of their senses, but insisted that it was only a figure dressed up in the weaver's clothes that was shown them.

Downie was tried for the violation of the churchyard, and fined heavily. (Page 125.)

15. **Ogston's Med. Juris., p. 67.**—In the "Edinburgh Monthly Journal" for February, 1854, Dr. Kinloch has related a case of mistaken identity under the following circumstances:—The body of an old man was found on the bank of the Dee, at Drumoak. The left ear and the first

finger of the left hand were wanting—the mutilation apparently of long standing. Two young women claimed the body as that of their father, who had been in the habit of leaving home for weeks at a time, and who had lost his left ear and left forefinger. On the return of the daughters and friends of the supposed party from his funeral, the boatman of a ferry which they had to cross, asked them for whom they were in mourning, and on receiving their answer, laughingly informed them that he had only half an hour before ferried their father over alive and well, which, on reaching home, they found to be true. Whose the body was which they had interred was not discovered. (Pages 125, 128.)

16. **Beck's Med. Juris., p. 377.**—J. Parker, living at New York in 1804, was mistaken for a man named Hoag, and charged with bigamy. He resembled Hoag in having a scar on his forehead, a mark on his neck, and a lisp in his speech. He differed from him, however, in having no scar on his foot. Further, an alibi in the case of Parker was distinctly proved. (Pages 128, 157, 158.)

17. **Gazette Médicale, March, 1847.**—(*Case before the Court of Assizes at Brabant,* 1846.)—A question arose as to whether a certain prisoner was the same man that had been convicted of forgery eighteen years previously (1828). The man convicted in 1828 had on his arm a brand-scar (D) made with a red-hot iron. The accused had no such mark. M. Vandelaer contended that the absence of the mark was no proof of non-identity, considering the length of time that had elapsed, and the probable use of artificial means to effect its removal. Others differed from his conclusions, but the Court decided in favor of the identity. (Pages 128, 156, 161, 163.)

18. **Case of Stuart.**—(*Old Bailey,* 1834.)—The non-identity of a prisoner proved by the absence of a cicatrix denoting the removal of a wen from the hand. This mark was known to have existed in the case of the true culprit. Mr. Carpue stated in evidence that "it was impossible, in his opinion, to remove such a wen without leaving a cicatrix." (Pages 128, 156.)

19. **Beck's Med. Juris., Vol. I., p. 655.**—A child (F. N.) was lost when it was about four years old. Two years after it had been missed a child was discovered, which was believed, by the voice and general appearance, to be the one lost. Proof of identity was attempted by a cicatrix produced by the operation of bleeding on the right arm (the child lost having been bled when sixteen months old) and the cicatrix of an abscess on the left knee (also known to have existed). The child found, however, was marked with small-pox, from which the child lost had not suffered. The surgeons, moreover, differed as to whether the mark on the arm was due

to bleeding or to the opening of an abscess. The Court decided against the identity. (Pages 128, 151, 156.)

20. **Ann. d'Hyg., 1855, Vol. I., p. 201.**—(*M. Tardieu.*)—A man (Aubert) in 1843 was charged with a robbery. His defence was that at the time it was committed he was undergoing imprisonment under the assumed name of Solignon. On searching the records it was found that a man named Solignon was in prison at the time named, and was described as tattooed with certain characters on both arms. Aubert stated that he also was tattooed, but had removed the marks by chemical means. Tardieu discovered on very minute examination slight signs of tattoo marks, but found that they did not correspond with the marks recorded as existing on the arms of Solignon. (Pages 128, 167.)

21. **Ann. d'Hyg., 1870, Vol. II., p. 459.**—(*Dr. Horteloup.*)—A man was tattooed when eighteen years old with China ink. At the age of 30, a bar of white-hot iron fell on the tattooed portion of the arm. Twelve years afterward a white cicatrix only was found to exist where the iron fell. Although the tattoo was obliterated, faint white lines existed which clearly showed the original design. (Pages 128, 167.)

(For a similar case see "Ann. d'Hyg.," 1872. Vol. I., p. 423, by M. Bois de Loury.)

22. **Amer. Journ. of Med. Sciences, Vol. LXXV., p. 44.**—(*Dr. Maury and Dr. Dulles of Philadelphia.*)—A series of fifteen cases recorded where syphilis followed tattooing. The professional tattooer moistened his pigments and needles by placing them in his mouth. The reporters do not suggest that it was the saliva which was the medium of inoculation, inasmuch as syphilitic ulcers were found in and around the tattooer's mouth. (Page 152.)

(See also "Ann. d'Hyg.," 1855, p. 175.)

23. **Lancet, 1872, Vol. I., p. 701.**—(*Dr. Gascoyne.*)—Report of a man tattooed over his entire body. He paid £40 to have the operation performed. (Page 128.)

24. **Lancet, 1872, Vol. I., p. 166.**—Male, æt. 40.—Tattooed in Vienna over his entire body as a punishment. (Page 128.)

25. **Brit. Med. Journ., 1877, Vol. II., p. 834.**—(*Dr. Horace Jeaffreson.*)—Tattoo marks caused by coke-dust accidentally getting into wounds. (Page 164.)

26. **Case of Gottlieb Ebermann.**—(*Casper*, Vol. I., p. 81; *Vierteljahrss.*, 1872, Vol. I., p. 274, and 1853, Vol. I., p. 338; "Med. Times and Gazette," Dec. 11, 1852.)—A man was found murdered in the neighborhood of Berlin, and the body was believed to be that of Gottlieb

Ebermann, who at that time was missing. It was stated, however, that eight years previously Ebermann had been cupped and also tattooed, although, strange enough, neither his wife nor his three sisters knew of the tattoo. A man of the name of Schall was accused of the murder, and the question of identity was the only missing link. Casper was consulted, and gave as his opinion that cupping and tattoo marks were not indelible. The man was convicted. (Page 128.)

27. **Ogston's Med. Juris., p. 69.**—The body of an idiot boy was disinterred for dissection by some medical students. After a considerable portion of the body, including the face, had been dissected, it was discovered by his relatives that the body had been carried off from the churchyard; and a search having been established, it was traced to the custody of the students. They were accordingly brought to trial. The body of the boy, when found on the dissecting-table, was so disfigured that there was only one means left of proving its identity. The boy had a whim during life of permitting his nails to grow, and had not allowed them to be cut for many years previous to his death. They had consequently curled round the tips of his fingers and toes till they had thus come to extend along the palmar and plantar surfaces in a strange way. The counsel for the prosecution availed himself of the knowledge of this fact; and his proof seemed to be complete, when a late shrewd and intelligent member of the profession came forward and gave in evidence that it was not an unusual circumstance for the nails to grow for several inches after death. This astounding statement so nonplussed the judge that the case was allowed to drop as not proven. (Page 127.)

28. **Ogston's Med. Juris., p. 70.**—(Case of Auguste Dautun.)—On the 18th of November, 1814, Auguste Dautun was assassinated in Paris by his own brother. On the day following, some boatmen found in the Seine a human head wrapped in a dishcloth, in the corner of which were the letters A. D. Other portions of the victim, with two entire thighs and legs, were discovered the same day near a public *fosse d'aisance.*

It became of importance to ascertain if the person thus discovered were actually Dautun, and as that individual had been lame, it was necessary to demonstrate that one limb was shorter than the other, which could not readily be known from the appearance of the fragments.

The examiners, of whom the celebrated Dupuytren was one, after describing the height, the complexion, the color of the hair, the teeth, the wounds present, and the situation of a wart on the face, carefully inspected the lower extremities, and especially the bones and soft parts entering into the formation of the hip-joints, from which they were led to draw the following conclusions:—1st, That the man examined must have had, when a child, disease of both hip-joints. 2d, That these diseases, although at a

remote period, and cured, must have left a remarkable degree of deformity of the hips and pelvis; must have led to difficult progression, and probably lameness; and certainly to a painful and disagreeable waddling of the body on the lower limbs. An exact comparison of the two limbs in regard to their length, and an examination of the soles of the feet, led them to believe that the right lower extremity was shorter than the left, and that the individual must have supported the weight of the body in progression and in standing on the ball of the toes, not on the whole sole. (Pages 128, 129, 152.)

29. **Ogston's Med. Juris., p. 72.**—The body of a lad, æt. 16, was recovered from the water after having been drowned ten days previously, and afterward exposed to a tempestuous sea. His father could not identify the body as that of his son, but the mother did from the existence of two pimple-looking projections on the front of the chest, which proved to be supplementary mammæ. (Pages 126, 128, 151, 152.)

30. **Beck's Med. Juris., Vol. I., p. 662.**—The identity of a girl (Salomé Muller) taken as a slave was proved after an interval of fifteen years by two moles the size of coffee grains on the inside of the thigh. (Page 128).

31. **Taylor's Med. Juris., Vol. I., p. 131.**—(Case of the woman Brown, murdered by Greenacre, 1837.)—Various parts of the body were found at different intervals of time in different parts of London, and when put together were found to fit exactly. The fifth cervical vertebra had been entirely, and the femurs partially, sawn through. The parts of the thigh-bones not sawn had been broken about an inch below the trochanters. Identity was established by this and by the peculiarity of a malformed uterus. Further the hands were horny, as of one used to hard work, whilst the head exhibited the peculiarities of the lower orders of the Irish. (Pages 126, 127, 128, 129.)

32. **Taylor's Med. Juris., Vol. I., p. 131 (1839).**—The arm and scapula of a child were found in a dusthole, and the head and body, minus an arm, in a ditch at some distance off. The identity of the several parts as belonging to the same individual, was established by the absolute correspondence between the muscles, vessels, etc., when fitted together. (Page 129.)

33. **Taylor's Med. Juris., Vol. I., p. 131.**—The head and mutilated body of a female were found in various places about Brighton. The identity of the several parts was established from the precise fitting together of the vertebræ, four cervical vertebræ being attached to the trunk and three to the head, and also by the exact correspondence in the case of the divided vessels of the neck and of the tracheal rings. (Page 129.)

34. **Taylor's Med. Juris., Vol. I., p. 131.**—("Guy's Forensic Med.," p. 32; *Report of the Trial of Professor Webster by Dr. Stone of Boston.*)—(The murder of Dr. Parkman, Boston, U. S., 1850.)—In the vault of Professor Webster's laboratory, a pelvis, right thigh, and left leg were discovered. In the cinders of the furnace were also found portions of (apparently) cranial bones, fragments of vertebræ, blocks of artificial teeth (recognized by a dentist as the teeth he had made for Dr. Parkman) and some gold plates that had been heated, but corresponded to a block in the possession of the dentist, and was of peculiar shape, owing to a great natural irregularity in the jaw of the murdered man. The gold in the act of heating had imparted a pink color to the teeth. In a box, embedded in tan and minerals, were found the entire trunk of a human body, with the left thigh from hip to knee. All the parts found, when put together, corresponded. There were no duplicate parts, but the head, arms, and hands, and the feet and right leg from knee to ankle were missing. The parts found resembled in all points the body of Dr. Parkman. There were other points that confirmed the scientific evidence. Thus the facts proved:

1. That the skeleton was that of a male between 50 and 60. (Dr. P. was 60.)
2. That the portions found, extending from the seventh vertebra to the outer malleolus, measured 57½ inches. On an average the measure from the sole of the foot to the outer malleolus is 3 inches (= 60½ inches), and from the top of the head to the sixth cervical vertebra 10 inches (= 70½ inches). Thus 70½ inches was the estimated height of the man of whom these were the remains. (Dr. P. was 71 inches high.) (Pages 129, 130, 135, 147, 181.)

35. (The murder of Harriet Lane.)—(The Whitechapel Tragedy.)—In November, 1875 (*C. C. C.*), Henry Wainwright was tried and found guilty of the murder of Harriet Lane, a woman with whom he cohabited. Two bullets were found in the brain, and a third amongst the hair, flattened by forcible contact with the skull, proving she had been shot; but in addition it was also evident that her throat had been cut, one carotid artery having been severed. The crime was discovered by a workman, who noticed a mutilated hand protruding from a badly smelling bundle, wrapped in American cloth. The prisoner was removing this and another bundle in a cab, and was smoking to hide the odor. A *danseuse* of his acquaintance was in the cab with him. When a policeman could be found to stop the cab it was discovered that one parcel contained the decomposed trunk of an adult female body. The contents of the second bundle disclosed the head of a female so covered with lime [and chlorinated lime] that it was difficult to guess her age. The arms and legs were also in the parcel. In the Whitechapel premises a new spade, soiled with lime, etc., and a grave

under the floor containing disinfectants, were discovered. The poor woman had disappeared nearly twelve months previously (September, 1874). She had had two children. The body was identified by some jewelry found on the premises. It was partly mummified, and partly converted into adipocere, and had been cut into ten different portions. It was very roughly dismembered, so that a part of the pelvis was connected with the thighs. The medical witnesses supposed her to be about twenty-five years of age, and five feet high. There were two distinct fractures of the skull, due to the two bullets. Mr. Larkin, the medical witness first called, said that one of the bullets had entered during life. This he judged from the extravasation of blood underneath the scalp for a considerable distance around the wound. There was also extravasation *within* the skull, following the direction of the bullet. A *scar* was noticed on the right leg. "It was an elongated scar as big as a shilling, but the puckering or drawn skin was much bigger. It was such a scar as a burn, say from a red-hot poker, would produce." He also deposed, that owing to the extravasation of blood in or about the parts, the throat must have been cut either just before or immediately after death. The bullets were flattened, but had been conical. One weighed 66 grains, one 78, and the third 72 grains. *The hairs on the shovel were proved by Mr. Bond to correspond with those of the deceased.* "The throat wounds were either homicidal, or had been inflicted suicidally by a left-handed person." Mr. Larkin gave it as his opinion that the deceased had had children, partly from the *lineæ albicantes*, and partly from the appearance of the uterus. ("British Medical Journal" for December 11, 1875, No. 780.) (Pages 127, 128, 129, 130, 169.)

36. **Dr. Taylor's Med. Juris., Vol. I., p. 133.**—("Med. Gazette," October 31, 1857, p. 445.)—(Waterloo Bridge Case, Oct., 1857.)—Examination of the remains of a body (23 portions in all, weighing 18 lbs.) found in a bag on one of the buttresses of Waterloo Bridge. The parts accurately fitted one another. The bones had flesh adhering to them, and the limbs had been both cut and sawn asunder. The head, 7 cervical and 7 upper dorsal vertebræ, the hands, the feet, and some portions of the left side of the chest were missing.

Dr. Taylor arrived at the following conclusions:—1. That the remains were those of a person of the male sex, of adult age, and of at least 5 feet 9 inches in stature. 2. That the parts found presented no physiological or pathological peculiarities by which they could be identified as belonging to any particular individual. The only fact observable under this head was, that the portions of skin remaining were thickly covered with dark hairs, and that the deceased was probably a dark hairy man. 3. That the remains presented no appearance of disease or of violent injury inflicted during life, with the exception of a stab in the space between the third

and fourth ribs on the left side of the chest. This stab was in a situation to penetrate the heart and to cause death. It had the characters of a stab inflicted on a person, either living or only recently dead. 4. That these remains had not been dissected or used for the purposes of anatomy. All those parts of the human body which are useful to an anatomist had been roughly severed and destroyed by a person or persons quite ignorant of their anatomical relations. They had been probably cut and sawn before the rigidity of death had ceased, *i.e.*, within from eighteen to twenty-four hours after death; and in this state had been partially boiled and subsequently salted (placed in brine). The body of deceased had not been laid out or attended to like that of a person dying from natural causes, whose body might be lawfully used for anatomical purposes. 5. That the person of whose body these remains were a part, may have been dead for three or four weeks prior to the date at which they were examined. (October 21, 1857.)

The murderer was not discovered. (Pages 126, 128, 129, 130.)

37. **R. v. Sheward.**—(*Norwich Lent Assizes*, 1869.)—Examination of certain portions of the mutilated body of a female adult. The medical evidence fixed the age at from 16 to 26. It turned out, however, that the woman was 54 (according to the man's own confession), and that he had mutilated after murdering her. Some portions of the body had been afterward boiled. (Taylor, "Med. Juris.," Vol. I., p. 149.) (Pages 126, 129.)

38. **The Thames Mystery.**—(For details see "Daily Telegraph," and other newspapers of September 5 to 20 inclusive.) Fragments of a woman's body were discovered in various parts of the Thames, from Wandsworth to Woolwich. Each leg had been divided into three parts, thigh, leg, and foot. The shoulders had been cut by sawing through the clavicle and scapula, and were taken by the police for thighs. The arms had been divided into three. The scalp, face, etc., were skinned; the right and left breasts, the left half of the pelvis, the lungs, etc., were all discovered separately. The mutilation generally was done with want of skill. Whilst some joints had been cut through, other parts had been severed with a fine saw. Smears of tar were found on some parts of the body. Correspondence of parts was proved, and enough was found to make it probable that the woman's age was about forty. There was a scar on the left breast, 3 inches by 2, a light brown mole on the inner side of the right nipple, a small mole on the right side of the neck; and a large wound on the right temple caused by a blunt instrument. There was rather short and black hair on the head (8 or 9 inches long), and a thin dark moustache. There was a large bruise on the front of the right thigh. On the front and inner surface of the right arm, near the elbow, there was a small scar, but near the right knee a large white scar, two inches in

diameter was apparent. The surgeon who examined these remains came to the conclusion that the body had been cut up whilst warm, and that the bruises were inflicted during life. The height he fixed at about 5 feet 3 inches.

[It might have been thought that these scars and moles were ample means of identification. However, the mystery was never solved, and an open verdict of "Wilful murder against some person or persons unknown" was returned. The tar made some think that a bargeman had committed the crime; whilst others thought the fine saw pointed to a cabinet-maker or carpenter. It could not be attributed with any show of probability to a medical student, as it was during the recess, and the mutilation was far too clumsy for any one possessing the least knowledge of anatomy.] (Pages 128, 129.)

39. **Daily Chronicle, Jan. 14, 1880.**—(Mutilation Case at Hendon.)—(*Mr. Bond and Dr. Andrews.*) Case of self-mutilation, the large blood-vessels being cut through. The person afterward committed suicide by drowning.

40. **Taylor's Med. Juris., Vol. I., p. 136.**—In 1838 a portion of a body was found in a dust bin in the City, and believed to be a human hand. It was afterward proved by Mr. Solly to be the fin of a turtle. (Pages 130, 133.)

41. **Guy's Forensic Medicine, p. 31.**—(Taylor's "Med. Juris.," Vol. I., p. 137.)—(Case of widow Houet, from Briand.)—Body exhumed after eleven years. It was reduced to a skeleton, but the third to the sixth cervical vertebra and the right clavicle were held together by a dark mass of decomposed flesh, surrounded by twists of a small decayed cord, which suggested that she had come to her death by strangulation. The bones were clearly shown to be those of a female. The length and color of the hair and the state of the teeth were satisfactorily established, and identity further proved by a ring carved in facets on one of the finger-bones. There were several small, well-formed finger-nails remaining. (Pages 127, 130, 131, 133, 136, 169.)

42. **Taylor's Med. Juris., Vol. I., p. 137.**—(Case of Guérin at Versailles, 1829.)—Body exhumed after three years' interment. Identity proved by the disposition of the teeth, a malformation of the spine, and bowed legs. Death was believed to have been caused by blows on the head, inflicted homicidally. (Pages 131, 134, 135, 181.)

43. **Taylor's Med. Juris., Vol. I., p. 137.**—(Trial of Eugene Aram for the murder of Clarke, 1758.)—The body was exhumed thirteen years after interment, and the cause of Clarke's death found to be fracture

of the temporal bone. In this case the prisoner (Eugene Aram) contended that it was impossible to identify a skeleton after thirteen years, and that the fracture of the skull might be the result of accident during exhumation, or, at any rate, since death. The prisoner was convicted. (Pages 131, 135.)

44. **Taylor's Med. Juris., Vol. I., p. 159.**—(Recorded by *Orfila.*)—Identity established in the case of a skeleton, after two years' burial, by a peculiarity of the right hand and right foot, corresponding with a sixth finger and toe. (Pages 131, 132, 135.)

45. **Taylor's Med. Juris., Vol. I., p. 159.**—(From *Briand.*)—Identity established in a skeleton by the diseased condition of the spine and pelvis, together with other peculiarities connected with the legs and jaw. (Pages 131, 132, 135.)

46. **Taylor's Med. Juris., Vol. I., p. 160.**—In the case of the skull of an exhumed infant it was at first supposed that the child had suffered murderous violence, from certain holes found in the skull. These, however, were manifestly dependent, as was afterward proved, on deficient ossification. (Pages 131, 132, 135.)

47. **Taylor's Med. Juris., Vol. I., p. 157.**—An English gentleman residing in India, 1833, was charged with the murder of a native, Meer Khan. The evidence against the prisoner was of a twofold character: 1, that which preceded death; and 2, that which followed it. With regard to the first, it will be only necessary to refer to it briefly. There was great discrepancy in the statements of the witnesses, as to the manner in which the deceased was alleged to have been destroyed. It was shown that the deceased had received a beating at the hands of the accused, but it was not proved that the man had died in consequence of the beating. There was no effusion of blood; there were no marks of violence of any kind upon the body before or after death, unless, indeed, we except a burning of the skin of the legs, which was alleged to have been produced by burnt paper or straw, but the evidence respecting this was anything but coherent and conclusive. Be that as it may, however, there was no evidence to prove that the alleged burning was the cause of the man's death. Two of the men (natives) who said they had carried the dead body to be buried at midnight, testified to the presence of marks of burning, but contradicted each other respecting the appearance of the legs; one swearing that they were covered with plasters, the other that the wounds and burns were not covered. The latter witness prevaricated, and, when asked how he knew that the legs were burnt, replied that he judged so from their being *white*.

The testimony respecting the degree and effects of the violence applied

to the deceased during life being so inconclusive, it was left to the jury to decide whether a quantity of human bones produced were those of the deceased, as it was alleged by the witnesses for the prosecution, or whether they belonged to the skeleton of some other person. According to the depositions, they were found in the following manner: *Three months* after the burial, one of the witnesses who had assisted in burying the deceased, after some search, discovered, as he supposed, the grave, on the verge of the bank of the River Damoodah. The body, it seems, had been buried pretty deeply in the sand, above the common water-mark, at the distance of sixty or eighty yards from the bed of the river, at a place which the waters had never reached, or could reach only on extraordinary occasions. The bones were uncovered, but not removed until five days afterward. It does not seem to have been clearly made out whether other bodies were ever interred at that spot or not, nor was the grave properly identified as that of the deceased. The bones were subsequently examined by Mr. Cheek, a medical officer attached to the station of Bancoorah. He stated in his evidence that twelve of the vertebræ, six of the ribs, and the sacrum were wanting; that the whole of the bones found were clean and dry, and free from periosteum, ligaments, and cartilage; that *one rib was broken*, and apparently had an osseous callus (new bone) formed upon and around the fractured ends. The witness gave it as his opinion that the fracture must have occurred at least seven or eight days before death; he had never heard of an instance of exhumed bones being deprived of soft parts and ligaments by natural decomposition in three months. He should not expect the cartilages and ligaments to be separated from the bones within a year of the interment; he considered it, therefore, extremely improbable that these were the bones of the deceased or of any person who had died within three months from the time of examination.

From this evidence, as the reporter of the case remarks, several considerations suggest themselves; as, for example, the identity of all the bones as those of one individual, the age of the person, the nature of the bony excrescence or callus found on the broken rib, the time necessary for the formation of new bone in order to settle the period at which the fracture took place, the time required for the total spontaneous destruction of the muscles, tendons, ligaments, and viscera; also the time required for the spontaneous separation of the sacrum from the other bones in a man of the age of fifty or sixty. Many of these points, important as they were, were altogether passed over. The witness gave it as his opinion, that they were the bones of a *male* subject; but of this, he said, he could not be quite certain, as the sacrum was wanting. No opinion was asked or given as to the supposed *age* of the person to whom the bones belonged. Only one bone was produced in court, viz., the broken rib, with the deposit of callus (new bone) at its extremity. From the state of this callus there could be no doubt, supposing the bone to have belonged to the deceased, that the

fracture must have been produced about eight or ten days before death; therefore at some time previous to the violence employed by the prisoner. The non-identity of the bones as those of the deceased seems, however, to have been clearly established by the condition in which they were discovered. Even in a tropical climate the period that must elapse before the total destruction of the soft parts of the body in a grave so that nothing but the bare bones shall remain, must be considerably greater than three months. In one instance, in which a body was exhumed four months after death, the soft parts were still present.

Another curious feature in the evidence was the separation of the sacrum from the bones of the pelvis. The junction of these bones by ligaments and fibro-cartilage is perhaps one of the strongest in the body. In the skeletons of the young these bones are rather difficult of separation; but in the old, in whom anchylosis (or bony union) in general takes place to a greater or less extent, the difficulty of separating them becomes incomparably greater. It may be readily conceived, then, that the entire separation of this bone by decomposition would require, even in a hot climate, an extremely long period in a body interred in the ground—probably from three to ten years. Now, when we consider that the deceased had not been buried above three months, it is clear, both from the entire destruction of the soft parts, and separation of the sacrum, that the bones discovered on the bank of the river could not have belonged to the deceased, but must have been part of the skeleton of a person whose body had been buried in the spot many years before. There was, therefore, a complete failure of identity, and the accused was discharged. (Pages 128, 130, 136.)

48. Taylor's Med. Juris., Vol. I., p. 128.—(*Mr. Harris, of Redruth.*)—Remains of a male, æt. 24, identified by his brother, after twenty-six years' submersion in water in a Cornish mine. The means of identification were the skeleton, portions of clothes, the buttons, and the boots. All the soft parts were destroyed, but the skeleton was firm. (Pages 130, 133.)

49. Taylor's Med. Juris., Vol. I., p. 138.—(*Mr. Perfect.*)—Two brothers lived together. One brother suddenly disappeared, and the other brother left the house. Some years afterward, when alterations were being made in the house, a skeleton was dug up from under the floor. The surviving brother was charged with the murder of his brother, but it was proved that the bones found were those of a female, of short stature, and aged. (Pages 130, 147.)

50. R. v. Platts.—(*Derby Lent Assizes,* 1847.)—The complete skeleton (excepting three ribs and a few vertebræ) of a person who had been dead about eight months was found in a cesspool. The identity was established

by certain articles of dress (coat, hat, trousers, neckerchief, and two garters of different colors.) The flesh readily came off the bones, and fell into the soil. Medical evidence was given that the bones were those of a male, of from 23 to 30 years of age; that the skull had been fractured in several places (one on the forehead, a second over the left eyebrow, and a third across the base of the skull); and further, that the fractures were inflicted by some sharp-edged instrument during life, and that they were sufficient to cause death. The prisoner was convicted on this, and other evidence of a general character. (Pages 130, 131, 133, 135.)

51. **Taylor's Med. Juris., Vol. I., p. 140.**—(Case of Elizabeth Hunter, July, 1863.)—The body of a female child, æt. 8, that had been missing for sixteen months, was found in a nursery-ground at Islington. The bones in the first instance were believed to be those of a dog, until the skull, with hair upon it, and the lower jaw were discovered. The medical evidence fixed the age, but not the sex. The soft parts and also some of the bones were destroyed, but this was accounted for by their having only been superficially covered with earth. Identity was established principally by the clothing. (Pages 128, 130, 131, 133.)

52. **Supposed Murder of Lydia Atlee by Weekly Ball.**—(*Northampton Lent Assizes*, 1864.)—(For details see "Taylor's Med. Juris.," Vol. I., p. 151.)—In this case a body was dug up after fourteen years' interment. It was believed to be that of Lydia Atlee. There was some doubt, however, of the identity, the woman having been proved to have been at the time of death far advanced in pregnancy, whilst no fœtal bones or hair were found in the body exhumed. The medical man said that the bones of a fœtus, containing so much more animal matter than adult bones, might decompose, although he would not say they would entirely disappear in fourteen years. Dr. Markham thought some of the fœtal bones ought to have been found, although the hair might have disappeared. It was proved that the deceased had had a tooth (first molar on the left side) removed a fortnight before death, and this was found wanting in the jaw recovered. The cavity was partly filled up, which might be explained by the tooth having been extracted without the removal of its fangs. Accused discharged. (Pages 131, 181.)

53. **Ogston's Med. Juris., p. 69.**—The body of an infant found in a servant's box. It was dry and shrivelled. The sex could not be determined, but from the ossification of the lower epiphyses of the femur it was clear that it was a child born at or near full time. (Page 130.)

54. **R. v. Varney.**—(*Oxford Assizes*, 1837.)—A woman, proved to have given birth to a child, charged with burning its body in the grate.

A few remains only of the bones were found in the ashes. Convicted of concealment of birth. (Page 132.)

55. **R. v. Berryman.**—(*Guildford Assizes*, 1854.)—Charge of child murder against a mother. The delivery was proved. She said she burnt the body *after* its death and then buried the remains in the garden. The remains were found, but there was difficulty in proving that these remains corresponded with a fœtus born at term, and not to an older child. Prisoner acquitted because of the doubt. (Pages 132, 133.)

56. **Taylor's Med. Juris., I., p. 161.**—A fireman engaged in the engine-room at a coal-pit was missing. Blood being found on the door of the furnace, together with burnt portions of dress proved to belong to the deceased, suspicion arose that he had been murdered and his body burnt. Dr. Edwards examined the ashes of the furnace and found :—1. Portions of the occipital bone of a human skull; 2. Base of a skull and two fangs of teeth, viz., a fang of an incisor and a fang of a molar tooth ; 3. Portions of arches of the dorsal vertebræ ; 4. A portion of the lumbar vertebræ ; 5. A portion of a head, body, and humerus ; and 6. A portion of the head and joint of the femur or thigh-bone. These bones had been heated to a high temperature, which had destroyed their internal structure, but the external form was well preserved. They were human bones ! A chemical and microscopical examination of some of the clinkers showed that there was blood upon them, *having the character of human blood!* There was no doubt that these were the remains of the missing man. He was last seen alive at eight in the evening, and at four the following morning nothing remained of him but the few bones above mentioned. (Page 132.)

57. **R. v. Hanson.**—("Taylor's Med. Juris.," Vol. I., p. 509.)—(*Bodmin Lent Assizes*, 1856.)—Certain hairs were discovered on a stone picked up near the deceased, and the hair was found to correspond with that of the deceased. The prisoner had been seen with a stone in his hand resembling the stone on which the hair was found. He was convicted. (Pages 127, 169.)

58. **R. v. Harrington.**—*Essex Lent Assizes*, I., p. 509.)—In this case a razor was found, and proved to belong to the prisoner, on which were certain cotton fibres embedded in blood. In cutting the throat of his victim the murderer had also cut through the cotton strings of her night-cap. The similarity of the cotton fibres on the razor belonging to the prisoner and those of the strings of the deceased woman's night-cap was fully established. (Page 169.)

59. **R. v. Steed.**—(*Maidstone Assizes*, 1863.)—Certain hairs and also certain red woollen fibres, matted in blood, were found wedged under cer-

tain of the nail-heads in the boots of the prisoner. The hairs were proved to correspond with the hair of the deceased, and the fibres with those of a red woollen comforter worn by him at the time of his death. (Pages 127, 169.)

60. **R. v. Cass.**—(*Carlisle Summer Assizes*, 1860.)—Mixed up with the dried blood on a knife belonging to the prisoner were certain dark woollen fibres, resembling those from the coat of the deceased. (Page 169.)

61. **R. v. Teague.**—(*Cornwall Summer Assizes*, 1851, p. 476.)—A hammer discovered, on which were two white hairs, stated in evidence to be the hair of the eyebrows of the deceased. In defence it was stated that they were hairs of a goat.—"Med. Gaz.," 1851, Vol. XLVIII., p. 731). (Page 169.)

62. **R. v. Devine.**—(1864.)—Certain gray hairs, corresponding to those on the head of the deceased, were found on a poker that it was believed had been murderously employed. (Pages 127, 169.)

63. **Case of Rosetta Bishop.**—("Taylor's Med. Juris.," I., p. 512.)—In this case Dr. Harley found certain hairs on a hatchet, but no blood. The hairs were similar to those on the head of the deceased, whilst the absence of blood was explained by the circumstance that the injuries on the skull were contused wounds only. (Pages 127, 169.)

64. **Frazer v. Bagley.**—(Feb., 1844.)—In this case the wife of the plaintiff had had criminal intercourse with the defendant, and the two children last born were stated to be the offspring of the latter. The plaintiff, his wife, and all the children had dark hair, except the two youngest, and these had red hair, and the defendant also had red hair. This circumstance was regarded as indirect proof of the paternity of the younger children. (Page 177.)

65. **Ogston's Med. Juris., p. 60.**—A man (Benoit) suspected of having committed a murder, was proved to have had black hair at a given time, and fair hair three or four hours afterward. A hairdresser said it was impossible to effect such an alteration of color, but Orfila proved the possibility of rendering the hair light-colored by chemical processes. (Pages 127, 178, 179.)

66. **British Med. Journal, 1879, II., p. 346.**—Female, æt. 17. Lost the whole of her hair in the course of five days after a severe fright. (Page 177.)

[For cases of complete loss of hair see "Medical Times and Gazette," 1870, II., pp. 518, 551, 575.]

67. **Lancet, 1873, p. 675.**—(*Note of Abbé Lefevre.*)—A case of hair turning white in one night, said to be the result of a terrible dream. (Page 178.)

68. **British Med. Journal, 1873, I., p. 102.**—(*Mr. E. Wilson.*)—Loss of hair after a fright. The hair afterward grew of a white color, but ultimately turned black. (Pages 177, 178.)

69. **New York Med. Journal, X., p. 412.**—A change in the color of hair from a dark brown to red, after twenty years' burial. (Pages 134, 178.)

70. **New York Med. Journal, IX., p. 111.**—Case of death from the use of lead hair dye and carbonate of lead face powder. (Page 179.)

[See also "Med. Times and Gazette," 1877, Vol. II., p. 480.]

70a. **Med. Times and Gazette, 1877, II., p. 480.**—Cases recorded of the danger of lead hair dyes. (Page 179.)

71. **New York Med. Record, Aug. 18, 1877.**—See also "Med. Times and Gazette," 1877, II., p. 485.—(*Dr. Caldwell*, of Iowa.)—The author states that he was present in 1862 at the exhumation of a body which had been buried for four years. He found that the coffin had given at the joints, and that the hair protruded through the openings. He had evidence to show that the deceased was shaved before burial, nevertheless the hair of the head measured 18 inches, the whiskers 8 inches, and the hair of the breasts 4 to 6 inches. (Pages 127, 180.)

[A second similar case is also mentioned by the reporter.]

72. **Echo, Aug. 22, 1876.**—(Thames Police Court.)—A sergeant of police swore to having seen three lads ill use an old man, and that he was able to recognize them although he had only seen the assault by a brilliant flash of lightning. Mr. De Rutzen committed the prisoners for trial. (Page 212.)

73. **New York Med. Journal, XXII., p. 444.**—(From "L'Union Méd.")—(*Dr. Dumas.*)—Girl born with two teeth (lower middle incisors). —(Page 183.)

74. **Lancet, 1875, I., p. 880.**—(*M. Mattei.*)—Child born with two teeth (lower middle incisors). In this case the mother had also been born with one tooth. (Page 183.)

75. **Med. Times and Gazette, 1879, I., p. 495.**—(From the "Boston Med. Journal," March 6, 1879.)—Male, æt. 24. Had never had any teeth. (Page 183.)

76. Med. Times and Gazette, 1875, II., p. 676.—(From "Gaz. des Hôpitaux, Aug., 1875.)—(*M. Echerac.*)—A third dentition. Six teeth cut by a male, æt. 73. (Page 183.)

77. Boston Med. and Surg. Journ., Jan. 10, 1878.—(Referred to in "Med. Times and Gazette," 1878, I, p. 194.)—Third dentition in a male, æt. 77. (Page 183.)

78. R. v. Gibbings.—(*C. C. C.*, Aug. 20, 1846.)—In this case the prisoner was tried for the murder of his wife. Much turned on the nature of certain stains on the clothes of the prisoner, the wall, etc.

On the (α) jacket and (β) waistcoat, certain spots were found having the appearance of blood. Under the microscope blood-globules, *embedded in coagulated fibres*, and mixed with epithelium scales similar to those on the human scalp, were discovered. A brown hair was also found embedded in one of the spots. The stains were first of all digested in distilled water. A pink solution was obtained, in which flocculi of fibrin were found floating. The solution—

(1.) Had a pink color, which did not subside on standing. It was slightly darkened both by acids and alkalies, proving it was not a vegetable coloring body.

(2.) Frothed considerably when shaken.

(3.) Turned a greenish tint on the addition of chlorine water.

(4.) Deposited flocculi of albumen on the application of heat.

(5.) Gave a precipitate with nitric acid.

(6.) Gave coagula with mercuric chloride.

(7.) Gave a precipitate with argentic nitrate.

(γ.) The spots found on the wall afforded evidence of *blood-globules, fibrin*, and *albumen*.

(δ.) A large spot found on a piece of matting afforded evidence of blood-globules and epithelial scales (probably from the scalp), but no fibrin.

By chemical tests this spot was proved to be blood.

(ϵ.) A spot was also found on the stairs. It had the appearance of a smear, or else of a blood spot that had been wiped. It was proved to be blood, but the presence of fibrin was doubtful.

(ζ.) Spots on certain pieces of beading taken from the window were examined. They had the appearance of smears made by a bloody hand. The markings of the cuticular ridges of the fingers were clearly defined. Examined by the microscope little transparent spots that might be mistaken for shrivelled blood discs were found.

The spots when digested in water formed a reddish solution, but the color subsided on standing in the form of a powder. The precipitate dissolved in HCl, and when potassic ferrocyanide was added to the solution Prussian blue was formed.

The following were Dr. Letheby's conclusions from his experiments in this case:—

1. That the spots on the (α) jacket, (β) waistcoat, (γ) wall, (δ) and matting, (ε) and the smears on the stairs were blood.

2. That the blood when spilt on the (α) jacket, (β) waistcoat, (γ) and wall was probably (from the presence of fibrin) *living* blood; whilst the blood when spilt on the (δ) matting and (ε) stairs (from the absence of fibrin) was probably dead blood.

3. That from the appearance and shape of the spots α, β, and γ, the probability is that the blood spurted upon them in jet-form from a living vessel, whilst in the case of ε, the blood stain was a smear by a bloody hand, or, a spot that had been wiped whilst wet or after it was dry with a wet cloth.

4. That the blood, judging from the character of the epithelial scales probably came from the scalp.

5. That the spots on the beading (ζ) were not blood. (Pages 184, 201.)

79. **R. v. Müller.**—(Case of Mr. Briggs, murdered by Franz Müller in a railway carriage on the North London Line, July, 1864.)—This was the first case where spectroscopic evidence was relied upon in a Court of Law in proof of certain stains being blood. (Dr. Letheby.) The prisoner was convicted, and ultimately confessed his guilt. (Page 184.)

80. **Eltham Murder Case, 1871.**—In this case Dr. Letheby relied partly on the microscopic, but chiefly on the spectroscopic, appearances of the stains in proof of their being blood.

Dr. Letheby's notes on this case [which, with his other papers are in my possession,[1]] is an admirable example of a medico-legal report for counsel:—

Memo.—Wednesday evening (May 3, 1871) received from Inspector Mulvany a brown paper parcel containing a pair of dark trowsers, a man's shirt, and a man's wide-awake cap.

On the evening of the following day (Thursday, May 4, 1871), I received from Mr. Mulvany a brown paper parcel containing a lock of hair, also a pair of man's boots, and a plasterer's hammer wrapped up in brown paper, and a vessel containing the uterus of a woman.

These were submitted to examination on Friday, the 5th of May.

(1.) I examined the *trowsers*. They were dark cloth trowsers, with white calico linings. I found a hair 7½ inches long upon the inner side of the left leg, a little above the knee. It was a human hair, of a brown color, and similar to the hairs from the lock given me by Mr. Mulvany. (Produce it.)

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[1] I publish this report, having received his permission to use his manuscript notes after his death in such manner as I might deem desirable.

I next found a number of spots, like blood spots, upon the front, and near to the bottom of the same left leg. I cut out several of them (perhaps six or seven), and have ascertained, from microscopic and spectroscopic examinations, that they are blood.

There were several stains on the right leg. One of these I cut out, but am not convinced it was blood. I do not think it was.

(2.) The *shirt* had been much worn, for it was very dirty, and had a stain of perspiration under the right arm. It was marked in the usual place with "E. W. Pook. 6." Upon the upper part of the wristband of the right sleeve, close to the edge, there was a blood-stain consisting of six small spots, one of which had gone through the fabric. I cut one of them out, and ascertained that it was blood.

(3.) The *cap or wide-awake* was made of felt, with stiff brim and soft crown. It was lined with silk, which was very dirty, and had Royal arms and the words "Best Quality" stamped or printed upon it. I observed three spots upon it like blood spots; one was on the right side of the upper part of the brim toward the back; a second was on the brim, in front and a little to the left, and a third was on the upper edge of the band, about two inches behind the bow, on the left side. I subsequently found another spot on the upper part of the brim at the back and to the left side. These were examined under the microscope and by the spectroscope, and found to be blood spots.

(4.) The *boots* did not show anything of importance.

(5.) The *plasterer's hammer* was covered with a thin coating of rust, as if it had been exposed to wet or to a damp atmosphere. At the hammer end, and between the cross notches, which were filled with mud, I saw three hairs. I scraped out the mud from between the notches and found five other hairs, from $\frac{1}{4}$ to $\frac{1}{2}$ inch long. They were human hairs, and very similar in color and structure to the hair given to me by Mr. Mulvany. (Have kept them.)

In a notch on the under side of the blade of the hammer, I found a clot on each side. One of these I have examined and found to be blood, the other I have kept. The blood was not soluble in water, but was soluble in citric acid, and gives the spectrum of hæmatin.

(6.) The *uterus* contained the membranes of a fœtus in the eighth or ninth week of pregnancy.

On Friday evening, the 5th of May, I gave all the things back to Mr. Mulvany, except the lock of hair and the uterus. At that time I had not completed the examination of the spots which I had cut out of the trowsers.

On Friday, the 12th of May, I received from Mr. Mulvany a brown paper parcel, which was sealed with seals of Metropolitan Police, and which he left at my house for me. The parcel contained the cap which I wished to examine, and a coat that I also desired to see. I found another

spot upon the brim of the cap, and ascertained that it was blood. I could not find anything on the coat. On Saturday morning, May 13, I gave these articles back to Mr. Mulvany.

Examination of a piece of blue cloth given to me by Inspector Mulvany, on Monday, July 17, 1871 :—

It was a piece of blue cloth about 3 feet long and 19 inches wide. It had been hemmed on three sides (the fourth side being a selvedge), but had become unsewn on two of the three sides. There were several holes in the cloth; and it was stained in many parts of a dirty red color, and in a great many other places with some white material. I ascertained that most of the red stains were blood stains of rather old date, although not so old as to have become entirely insoluble in water. The stains were evidently produced by the cloth having been used to wipe some bloody surface, and not by the spurting of blood upon it.

I find that the white material is white paint. (Page 184.)

81. **R. v. Wheeler.**—(St. Alban's Murder Case.)—(*Chelmsford Assizes*, Nov., 1880.)—In this case I gave evidence on certain stains found on the clothes of the prisoner, proving them to be blood from their spectroscopic appearance. I also fixed the probable age of the several stains from the condition of the blood-coloring matter. (C. Meymott Tidy.) The prisoner was found guilty, and ultimately confessed. (Page 184.)

82. **R. v. Day and the Tedburys.**—(Hungerford Murder Case, February, 1877.)—In this case, where three men were charged with the murder of a gamekeeper, I gave evidence that certain stains found on the prisoners' clothes, from their spectroscopic reactions, were blood. The two men on whose clothes the blood stains were found were convicted, and ultimately confessed their guilt. (C. Meymott Tidy.) (Page 184.)

CHAPTER IV.

THE CAUSES OF DEATH.

Sudden Death—The Modes of Death—COMA—SYNCOPE—Anæmia—Asthenia—APNŒA.

SUDDEN death (as the records of inquests a few years ago might have led us to suppose) does not necessarily result from heart disease. Various observers (prominent amongst whom has been Dr. Ogston)[1] have pointed out the large number of causes that may account for unexpected death, and how far these are capable of discovery and proof by post-mortem examination.

Amongst the causes of sudden death (excluding violence and poison) we may mention:—

1. Disease of the heart, especially fatty and brown degeneration; angina pectoris; aortic regurgitation; interstitial abscess; rupture of the heart or of its valves; diseases of the pericardium.

2. Diseases of the blood-vessels, especially aneurism and thrombosis. [The forms of aneurism most likely to end suddenly are intra-cranial, intra-pericardial, abdominal, and pulmonary.] Injuries to arteries such as occasionally occur from angular curvature, etc., have been known to cause sudden death. [See "*Gazette Hebdom.*," 1859, p. 524, "Sudden death in a case of angular curvature from perforation of the aorta" (M. Fuller). Also "*Gaz. Hebdom.*," 1861, p. 76, Sudden death in a similar case from perforation of the vertebral artery (M. Legouest).]

3. Large effusions of blood in the brain or its membranes. (Cerebral and meningeal apoplexy.)

4. Pulmonary apoplexy and hæmatothorax.

5. The sudden bursting of visceral abscesses.

6. Ulcers of the stomach, duodenum, or of other parts of the alimentary canal.

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[1] See "*British and Foreign Medical Chirurgical Review*," Vol. XLIV., p. 452, etc. [Ogston describes thrombosis of the heart and great vessels as present in 10 per cent. of his cases of sudden death.] *See* also Beck (*loc. cit.*, p. 510), who gives numerous references; also Dr. Christison's paper on Latent Diseases in "*Cyclopædia of Practical Medicine*," Vol. IV.; and Herrich and Kopp's "*Der Plotzliche Tod aus inneren Ursachen.*" Regensburg, 1848. Also a paper by M. Devergie in "*Annales d'Hygiène*," Vol. II., p. 145. 1838.

7. Extra-uterine fœtation; peri- and retro-uterine hæmatoceles; apoplexy of the ovary; rupture of the uterus.

8. Rupture of the urinary bladder, or of the gall-bladder, or of some other viscus from accidental violence or other cause.

9. Cholera, and certain zymotic diseases at times kill very rapidly.

10. Large draughts of cold water taken when heated. (The sudden effects resulting from imbibing large quantities of spirit come under the head of alcoholic poisoning.)

11. Mental emotions.

12. The accidental swallowing of foreign bodies, so as to cause blocking of the pharynx and obstruction of the glottis.

Such a list as the above, detailing some of the causes of unexpected death suggests the remark, that because a person dies suddenly, there being no evidence of violence or of poison, the action adopted by many coroners in not requiring a post-mortem examination, leaves the most important witness—the dead body itself—unheard, and the inquest so far valueless!

Many cases of sudden death, which fifty years ago were considered inexplicable, can now be ascribed to the sudden blocking up of a large blood-vessel. This may occur *in situ* in the right or left cavities of the heart or in the arteries, veins, or sinuses (*thrombosis*). Or, again, the formation of a solid plug having taken place at one portion of the arterial or venous system (notably in the auricles and ventricles, or upon the surface of the cardiac valves), the force of the current may cause its dislodgment and projection into the course of the circulation, until it becomes impacted in a vessel too small to allow its passage (*embolism*). When sudden death occurs from *arterial* embolism, it is usually one of the great arteries of the brain that is thus obstructed. A clot detached from any portion of the internal surface of the left cavities of the heart, finds a ready passage by the internal carotid to the arteries of the brain. This plugging takes place most commonly in the arteries of the *left* hemisphere. The symptoms produced are sudden inability to speak, paralysis of motion (usually of the right side), and, in fatal cases, coma. *Very* sudden death, however, in such cases is rare, the symptoms usually continuing for at least two days.[1]

In obstruction of the *right* ventricle, or of the pulmonary artery by clot, death may be very sudden. For instance, it is recorded that a young woman who had been under treatment in the Hôtel-Dieu at Paris for phlebitis of the left leg, was on the point of leaving the hospital, when she gave way to a paroxysm of laughter, and fell dead.

[1] Cf. Lancereaux, "*Anat. Pathologique*," p. 431.

The right ventricle and the pulmonary artery were found at the post-mortem to be plugged with fibrinous coagula, which were evidently fragments of similar clots occupying the diseased portions of the veins of the leg. In another case, death took place immediately after a paroxysm of anger and agitation—the pulmonary artery being found almost entirely blocked by coagula. The mere manipulation during a medical examination of a diseased vein, has been known to dislodge a clot which has plugged the pulmonary artery, and a similar accident has followed the removal of a bandage from the limb. (Massari, "*Wiener Med. Woch.*," 1875, No. 48.)

Phlebitis, leading to the formation and detachment of clots which may block the pulmonary artery, would seem to occur specially in gouty patients, and in pregnant and anæmic women. Thus it is recorded that in cases of gouty phlebitis of the femoral vein, the mere act of bending the thigh in getting into bed, has sufficed to detach a clot and determine the fatal issue. ("*St. Bartholomew's Hospital Reports*," Vol. X., 1874.)

The symptoms induced by plugging of the right chambers of the heart or pulmonary artery, are:—great dyspnœa (although air is observed to enter the lungs freely), pallor or lividity, with turgescence of the veins of the neck; coldness, and frequently cold perspiration; tumultuous and irregular action of the heart, with suppression of the sounds over the right cavities.

The Modes of Death.

The manner of dying is a subject full of medico-legal import. The uncertain, although at times valuable evidence of those who witnessed the death, and the positive or no less important negative evidence afforded by the post-mortem, furnish the data upon which the medical jurist will have to form his opinion. Respecting the evidence afforded by the post-mortem, this, as we have said, may be twofold—(1) *positive*, *i.e.*, where we can discover a definite cause of death, and (2) *negative*, *i.e.*, where, although a definite cause may not be recognizable, we are able to exclude certain diseases or injuries as even possible causes. And this latter use of a post-mortem is often as important as the former.

Adopting for want of a better the old classification of Bichat ("*Récherches sur la Vie et la Mort*," par Marie François Xavier Bichat: Paris, 1800), viz., (1) Death beginning at the head; (2) Death beginning at the heart; and (3) Death beginning at the lungs, we shall first of all tabulate the facts, and afterward remark on certain details.

TABULAR VIEW OF THE MODES OF DEATH.

I.—COMA (*Death beginning at the head*).

Pressure on the brain or medulla oblongata (*Compression, Apoplexy, Hydrocephalus, etc.*).

Blows on the head causing cerebral disturbance (*Concussion, Shock, etc.*).

Action of narcotic poisons, from their specific action on the brain and nervous system (*Opium, etc.*).

Action of certain mineral poisons (*Barium, Arsenic, etc.*).

Certain discharges and hemorrhages which, although incapable of producing syncope, paralyze the nervous centres.

Plugging of an artery supplying the brain by a clot or by solid material detached from any surface over which the arterial current has flowed.

Certain cases of kidney or of liver disease. (*Uræmic poisoning, etc.*)

II.—SYNCOPE (*Death beginning at the heart*).

(1.) **Anæmia** (*A deficiency in the quantity of the blood*).

Injuries to the heart or to the larger blood-vessels.

Hemorrhages from lungs, uterus, etc. (*Death by depletion*).

Discharges other than blood, but which indirectly drain the blood (*Extensive suppurations, etc.*).

(2.) **Asthenia** (*A deficiency in the power of the heart*).

Starvation.

Exhausting diseases (*Phthisis, Diabetes, Dysentery, Cancer, especially of stomach and œsophagus, Tumors pressing on thoracic duct, etc.*).

Action of certain poisons.

Certain injuries (*Concussions of the spine, Severe blows on the epigastrium, etc.*).

Severe brain lesions.

III.—APNŒA (ASPHYXIA) (*Death beginning at the lungs*).

This may be due to four causes :—

(1.) **A stoppage in the action of the respiratory muscles.**

This may result from—

Exhaustion of the muscles (*Debility, Cold, etc.*).

Loss of nerve power (*Injury to the upper part of the spinal cord, or division of the pneumogastric or phrenic producing paralysis of the muscles of respiration*).
Mechanical pressure on the chest or abdomen.
Tonic spasm (*Tetanus, Hydrophobia, etc.*).

(2.) A stoppage in the action of the lungs themselves.

This may result from—
Mechanical obstacles (*Entrance of air into chest through wounds in the thorax; Abdominal viscera entering the thorax through wounds in diaphragm, etc.*).
Division or compression of the eighth pair of nerves.

(3.) The entrance of pure air into, or the escape of impure air from, the lungs being prevented.

This may result from—
Foreign bodies in the mouth, nose, larynx, etc.
Submersion.
Suffocation, Strangulation, Hanging.
Want of air (*as in very high altitudes*), or want of a sufficient percentage of oxygen, although the diluent gas (like N or H) be inert.
Certain irritant gases (as SO_2, Cl, etc.) which produce spasm of the glottis.

(4.) The supply of blood to the lungs being prevented, from plugging of the pulmonary artery by a blood-clot. (*Embolism.*)

I. COMA.

(*Death beginning at the head.*)

The causes occasioning this mode of death are sufficiently indicated in the table. It is evident that accidents (as concussion), poisons (as opium), and disease (as apoplexy) may severally cause it.

Symptoms.—Stupor more or less profound. External impressions appear to be but feebly recognized. This loss of sensibility and consciousness gradually becomes complete, and deepens into death. The breathing becomes slow, irregular, and noisy (stertorous), and all voluntary control over respiration is lost. For a time, however, after consciousness has ceased, respiration may be imperfectly carried on.

Finally, the chest no longer expands, the blood is no longer aërated, and, as a result, the post-mortem appearances in the thorax where death begins at the head (coma), may differ but slightly from those found in death beginning at the lungs (apnœa).

Post-mortem appearances.—The arteries and *left* side of the heart empty. The *right* side of the heart and lungs moderately full, but not so engorged as after death from apnœa.

Possibly effusion (apoplexy or cerebral hyperæmia) may be found within the head.

II. SYNCOPE.

(*Death beginning at the heart.*)

This, as the table indicates, may depend on two distinct causes :—

(1.) Where there is a want of blood, but no want of heart-power (*Anæmia*).

(2.) Where there is a want of heart-power, but no want of blood (*Asthenia*).

(1.) Anæmia.

Causes.—These are sufficiently indicated in the table. It is only necessary to mention that anæmia may result from disease (rupture of an aneurism, uterine and other hemorrhages and discharges, etc.), or from accident (as on the battle-field from loss of blood). Very large losses of blood, whether external or internal, may prove almost instantaneously fatal.

Symptoms.—" A mortal paleness [or duskiness] in the cheek," and more especially in the lips. Cold sweats; dimness of vision; dilated pupils; vertigo (giddiness); a slow, weak, irregular, or fluttering pulse. Insensibility eventually sets in. There may also be nausea (or even vomiting), restless movements of the limbs (jactitation), and transient delirium, with frequent hallucinations of the sense of hearing, and flashes of light before the eyes. The breathing becomes irregular, with sighing, and at last gasping. There is often hiccup. Convulsions generally supervene, and may be repeated once or twice before death. In short the nervous system is paralyzed, because the supply of blood to the brain is deficient.

Post-mortem appearances.—If the heart be examined very soon after death it will be found *contracted*, and quite or nearly empty. In other words, the heart only stops because no more blood comes to it. Transfusion of blood or saline injections into the veins, and the effects of stimulants and nourishment in a fluid form are to be regarded as *influences in* a direction the reverse to depletion.

(2.) ASTHENIA.

The causes of Asthenia are sufficiently indicated in the Table.

Symptoms.—The hands, feet, and surface generally become cold. The circulation in the extremities is usually arrested first, so that the fingers, lips, nose, and ears become livid. The pulse becomes fèeble and frequent, and the muscular weakness extreme. The senses and intellect retain their full activity (sometimes, as Sir Thomas Watson says, even more than their full activity) to the last.

This clearness of intellect distinguishes collapse (especially abdominal collapse) from concussion, in which consciousness is temporarily lost. Asiatic cholera in the algide stage often furnishes a striking example of this condition. Thus patients supposed to be dead are able to hear every word spoken by those around, and manifest consciousness by signs when unable to speak even in a whisper.

Post-mortem appearances.—In asthenia, the heart's cavities are not contracted, but are either more or less full of blood, or, if empty, dilated and flabby. The former was the case in Sir B. Brodie's experiments on animals with the *upas antiar.*

SYNCOPE PROPER.

In death by *Syncope proper* we have a combination of anæmia with asthenia.

In syncope (and in anæmia generally) the tendency to death can sometimes be arrested by position. Thus, in venesection (as Dr. Marshall Hall suggested) the patient should be bled while sitting, so as to be laid down the moment symptoms of faintness occur. The loss of large quantities of fluid, as from tapping, or from emptying a large hydrocele, or from passing a catheter when the bladder is much distended, have been known to produce syncope and death. It is important, therefore, that patients should be tapped whilst sitting up in bed, and the effects on the pulse watched.

Sudden death from what is called *shock* (including mental emotion, joy, grief, terror, etc., fatal concussion, blows on the epigastrium, lightning and electricity, and some suddenly fatal forms of apoplexy) is probably the result of syncope. Such causes as those enumerated act through the *nervous system*, either on the cardiac ganglia of the sympathetic or on some other portions of that system, or upon certain definite tracts in the medulla oblongata or brain. The very mention of these subjects will show the difficulties which occur to the system-monger, and prove that it is only those familiar with clinical and dead-

house work that are competent in any case whatever to give an opinion as to the cause of death.

The general post-mortem appearances after death from syncope.—The right and left sides of the heart commonly contain an equal amount of blood.

The post-mortem signs of syncope are negative, death resulting from an arrest in the action of the heart, and consequently an arrest in the supply of blood to brain, lungs, and other viscera. As a rule, therefore, these organs and the capillary system generally are in a normal condition.

III. APNŒA [ἀ, and πνεω, to respire] (Asphyxia [ἀ, and σφύξις, pulse]).

(*Death beginning at the lungs.*)

Causes.—These are indicated in the Table.

Respiration is the natural means whereby that which is power is given to, and that which is poison is removed from, the blood.

As *anæmia* implies a deficiency in the *quantity* of the blood, but not necessarily any impairment in its quality, so *asphyxia* implies an impaired *quality* of blood, but not necessarily a diminished quantity.

Symptoms.—An intense struggle to breathe (sense of suffocation); vertigo; loss of consciousness; relaxation of sphincters; general convulsions.

[Note.—In apnœa, the difficulty of breathing precedes unconsciousness; but in coma, the unconsciousness precedes the difficulty of breathing.]

Post-mortem appearances.—The *right* side of the heart, veins, capillaries, and viscera are commonly engorged, whilst the *left* side of the heart and the arteries will be found comparatively empty.

In some cases of asphyxia, the right cavities of the heart have been reported as empty.—("*Lancet*," May 29, 1875, p. 776.)

There is always a danger in a post-mortem, especially after death by asphyxia, of the blood escaping from the heart when the head is opened before the thorax. It may therefore be well, where death by asphyxia is suspected, to examine the chest first. In such case, the pericardium should be laid open and the heart examined *in situ*. The right cavities should then be exposed, by which means good and undoubted evidence of the actual state of the right heart will be secured.—("*Lancet*," May 8, 1875, p. 668, and July 5, 1875, p. 809.)

It must be admitted that the determination of the immediate and precise cause of death is too complicated a subject of investigation to admit in all cases of an absolutely definite opinion being formed. It is often difficult to distinguish direct from indirect, and secondary from primary causes: or, given certain effects, to determine the precise cause for those effects. Nevertheless, admitting the truth of this, we must be careful not to overrate these difficulties. Thus the condition of the right heart and lungs occurring in apnœa would lead us to state positively that syncope in such case was not the cause of death. Again, given a large clot in the lateral ventricles of the brain, a sufficiently natural cause of death would have been discovered, which, although poison may have been taken or violence used, must lead us to regard both the poison and the violence in a very different light, as primary causes of death, to what we should if the clot were absent.

It is evident, however, that in many deaths a combination of causes may be found, and the pathologist may find it difficult to say which cause contributed most to the fatal result. Thus coma, syncope, and apnœa are often interdependent. The *nervous system* will be affected either by an injury to the heart, because the brain wants blood for its nourishment, or by an injury to the lungs, because it is necessary for the blood not only to be sufficient, but of good quality.

Again, the *circulatory system* will be affected by a want of nerve-energy, for nerve-force is required for the action of muscles whether of the chest or of the heart itself (innervation or paralysis of the heart and lungs), whilst the action of the heart needs a stimulus, which, if the respiratory system be out of gear, it fails to obtain.

Again, the *respiratory system* will be manifestly affected by lesions in the circulatory or in the nervous systems.

Thus the Germans speak of various combinations of the three modes of death mentioned, of which comato-asphyxia, or a combination of death beginning at the brain and lungs, is the most important practically.

Admitting this interdependence of the nervous, circulatory, and respiratory systems, it is worthy of remark, that the interdependence is not uniform in degree, the respiratory and circulatory systems depending less on the nervous, than the nervous system depends on the respiratory and circulatory.

The question, how far the cause of death may be determined after the lapse of a considerable interval, needs consideration. It is certain, that the natural causes that show themselves only by minute pathological conditions, will in most cases disappear after prolonged burial. Again, putrefaction will prevent definite conclusions as to the

precise cause and nature of contusions inflicted during life. But wounds (such as gunshot or penetrating wounds), or the presence of foreign bodies in wounds, or rupture of the larger blood-vessels or of the viscera, or the marks of hanging and strangulation, or possibly in infants some proof of infanticide (the lungs themselves ordinarily resisting decomposition for a long time, and putrefaction not materially interfering with their examination), or proof of the uterus having been pierced by instruments or otherwise injured, may each and all be discovered even when putrefaction has far advanced.

CHAPTER V.

THE POST-MORTEM.—A MEDICO-LEGAL INQUIRY.

General Details to be observed in conducting a Post-mortem for Medico-Legal Purposes: I. Examination of the Surroundings of a Body; II. Examination of a Body before the Removal of the Clothes; III. External Examination of a Body after the Removal of the Clothes; IV. Internal Examination.—The Cranium.—The Thorax. —The Abdomen.

Table of Weights of Viscera, etc.—Table showing Maturity at Different Periods of Utero-Gestation. (Pages 270, 271.)

In all cases where dispute or question is likely to arise respecting the results of a post-mortem examination, it is advisable that it should be conducted by, or in the presence of, at least two experts. No one in the least degree inculpated or personally interested (even if a medical practitioner) should be present, but a suspected person should be represented at the examination (if he sees fit) by an expert of his own appointment.

A post-mortem should not be conducted by artificial light unless in case of great emergency. Certain characteristic tints, such as the yellow color produced by nitric or by picric acid, would probably escape notice either by gas or candle light.

In the case of a frozen body, it should first of all be allowed to thaw. This should be effected by placing the corpse for some hours before the examination is commenced in a warm room, and not by immersion in warm water.

In all cases where microscopical or chemical examinations are thought necessary, the parts to be examined should be placed on one side during the autopsy, but submitted to examination afterward with the least possible delay.

The two essentials of a well conducted post-mortem examination for medico-legal purposes are (1) *completeness* and (2) *method:*—

(1.) The post-mortem must be *complete*, in order that the operator may be able to speak definitely as to what *is not* the cause of death, as well as what *is*. Because, on examining the brain, the medical jurist may find sufficient to account for death, he is not justified in omitting the examination of the thorax and abdomen. Or, again,

because he finds in the lungs extensive and advanced tubercular disease, he is not thereby excused from examining the head and belly. Violence may coexist with disease, and the medical jurist must inform himself fully both of the extent of the violence and the nature of the disease. Every post-mortem should be so conducted that positive evidence can be given respecting the condition (normal or abnormal) of each part and viscus.

(2.) The post-mortem must be conducted with *method*. An unmethodical examination is not only likely to be incomplete, but is certain to be more or less imperfect, the condition of the parts being artificially and prematurely obliterated.

Every detail should be recorded in writing. The notes should be so written that they are clear and intelligible both to medicals and non-medicals, and in such form that they can be used in the witness-box to "refresh the memory." They should be dated and paged, the name and address of the deceased being written upon each page.

A post-mortem examination is best delayed until twenty-four hours after death, but the precise period at which it was conducted should in every case be recorded. Putrefaction or long burial affords no justification for refusing to make a post-mortem (pp. 92, 253). Much may be learned from an examination conducted at a long interval after death; such as, *e.g.*:—

(α.) Abnormalities.

(β.) Injuries to bones.

(γ.) Color and amount of hair.

(δ.) Foreign bodies in various parts (such as bullets, etc.).

(ε.) Poisons ("*Indian Med. Gazette*," January 1, 1875, p. 4).

(ζ.) Sex.

(η.) If a female, the existence of pregnancy. If any soft parts remain, the question of recent delivery may also possibly be determined.

I.—Examine the Surroundings of a Body.

If possible, make a sketch of, or at least describe accurately in words, the position in which the body was found when first seen, especially its position in relation to articles of furniture—to instruments of violence—to glasses, cups, and bottles, from which poison may have been taken (remembering that prussic acid is often given in beer and arsenic in tea)—and to blood-stains on the floor or elsewhere.

All articles likely to prove important should be marked, so that they may afterward be recognized. They should be carefully preserved under lock and key.

II.—Examine the Body before the Clothes are removed.

Note :—

(1.) The attitude and position of the limbs.

(2.) The state of the clothes ; *i.e.*, whether torn, or cut, or stabbed ; whether marked with blood-stains, stains of acid, etc. [If the clothes be cut, the exact position of the cuts, and their correspondence or otherwise with injuries on the body should be recorded. The clothes must in such case be carefully preserved for evidence.]

(3.) The hands and nails. [Note and preserve any articles (hair, clothing, etc.) that may be found grasped in the hands. Record whether the hands are scorched or blackened from powder or otherwise injured from the recoil of a pistol, or stained with blood, etc.]

[From considerations 1, 2, and 3, some conclusion may be formed whether a struggle occurred before death.]

(4.) The color, and any peculiarities in the growth of the hair on the head and face.

(5.) The teeth. (Are the teeth regular or irregular ? What teeth (if any, are wanting ? Note their state of preservation. The presence of false teeth, etc.)

(6.) The color of the eyes. [The color of the eyes at a post-mortem is as a rule (excepting when black) difficult to determine.]

[From considerations, 4, 5, and 6, certain important details may be obtained which would be of use should any question of identity arise, or the body be that of a person unknown.]

(7.) Post-mortem rigidity.

(8.) The condition of the eyes and pupils. (Are the eyes " dreadfully staring " or " decently closed " ? Are the pupils large, small, or unequal ? Is the cornea transparent and tense, or opaque and loose ?)

(9.) The mouth and tongue. [Is there any froth at the mouth, or any peculiar smell, such as the odor of prussic acid, chloroform, etc., discernible ? Has the tongue been bitten ? Is its position natural ?]

(10.) The color and expression of the face. [The face will generally be found livid after death from apoplexy, or from suffocation (hanging, etc.), or where much struggling has preceded death, or after natural death in which the lungs, right heart, and venous system are much gorged. It is usually pale after death from the action of acids (even of prussic acid), alkalies, most vegetable poisons, blows upon the epigastrium, and injuries to vital organs. On the other hand, after poisoning by alcohol, opium, the oxides of carbon, and chloroform, it may be either pale or red. In most violent deaths, the features ex-

hibit manifest signs of having been convulsed. After death from hemorrhage and apoplexy, also after poisoning by opium, carbonic acid and other narcotics, the face is placid, and in cases where there has been great loss of blood usually presents a waxy appearance. Corrosive poisons, especially such as produce severe abdominal symptoms, frequently cause a pinched and anxious expression, like the facies hippocratica.]

All the clothes are now to be removed.

III.—Examine the Body Externally.

Note any circumstances tending to throw light on the *time* of death. Such as—

(1.) Temperature.
(2.) Presence and extent of rigidity.
(3.) Degree of putrefaction.

Note further—

(1.) *Height* and *Weight.*
(2.) *Probable age.*
(3.) *Sex.*
(4.) *Development* (muscular or not).
(5.) *General condition of body* (ill or well nourished). [Care must be taken not to mistake dropsy or gaseous distention for fat.]
(6.) *Color of skin* generally, and *marks or scars* on the skin (*e.g.*, ulcers, cicatrices of burns, tattoos, etc.).
(7.) *Abnormalities* (*e.g.*, spinal disease, club-foot, excess or deficiency of limbs, etc.).
(8.) *Stains* (*e.g.*, blood, fæces, semen, etc.).
(9.) Determine *the presence or absence of foreign bodies* in the mouth, nostrils, and anus, and, in the case of females, in the vagina.
(10.) *Injuries*, such as *contusions* (not to be confounded with post-mortem hypostases), and *wounds*. [To distinguish between a life bruise and a post-mortem hypostasis, make an incision through the skin. In a life bruise the true skin is red and blood-stained, extravasation occurring in the subcutaneous tissue, but in a post-mortem hypostasis the discoloration is superficial. If any wounds exist, note *their extent*, *depth*, and *direction* ;—in other words, are they deepest from right to left, or *vice versâ*. Determine, if the wounds were prolonged in the same

line, where the knife, bullet, or other weapon causing them would emerge? If necessary, dissect carefully (*but do not probe*) to see what parts are implicated. Note the condition of the edges of wounds. Wounds inflicted after death generally discolor rapidly around the edges, and acquire a dry, brownish, parchment-like appearance. Note if there be any marks of a cord round the neck. If a cord be found, record the position (front or back) of the knot.]

Should injuries exist on a body, and a weapon be found supposed to have caused the injuries, the medical jurist must consider—

1. Whether the injuries could have been caused by the weapon produced?

2. Considering the nature and direction of the injuries whether or not they could have been self-inflicted?

If no weapon be produced, and injuries exist on the body, he must then consider—

1. What kind of weapon was probably used to inflict them?

2. In what manner was the weapon used, and in what direction was it held for the purpose?

(11.) [In the female.] Note with great precision all injuries about the genitals, and the presence or absence of the signs of virginity.

In New-born Children determine Maturity. (See Table II., p. 271.)

For this purpose note as follows:—

(*a.*) Length and weight.

(*b.*) Presence or absence of the membrana pupillaris.

(*c.*) Length and state of the hair.

(*d.*) Length and condition of the nails.

(*e.*) The genital organs:

(*α.*) *in males*, the condition of the scrotum, and the position of the testicles.

(*β.*) *in females*, the condition of the external organs of generation.

(*f.*) Centres of ossification.

[Here note especially the condition of the inferior epiphysis of the femur and the upper epiphysis of the tibia. For this purpose open the knee-joint by a transverse cut below the patella.]

(*g.*) Condition of the umbilical cord.

(*h.*) Size of the fontanelles.

(*i.*) Condition of the cartilages of the nose and ears.

IV.—Examine the Body Internally.

And here two remarks are suggested :—

(1.) Avoid mistaking post-mortem hypostases for morbid or abnormal conditions of the several viscera and tissues.

(2.) If there be any suspicion as to the cause of death, that cavity is to be first opened, and that viscus first examined, in which it is expected the chief changes will be apparent (page 252.) Failing this the order as described is to be followed.

(A.) THE BRAIN AND SPINAL CORD.

To make an examination of the head in a systematic manner proceed as follows :—

If the hair be thick, it may be well in a doubtful case of injury to remove a portion, or even to shave the head. This is, however, very seldom necessary. Make an incision down to the bone across the head from ear to ear, and reflect the scalp. Note the amount of blood in the scalp, and look for fractures or injuries to the outer table of the skull. Saw carefully round the skull about half-an-inch above the meatus auditorius externus. Remove the calvaria, and note the condition of the dura mater. The dura mater should now be carefully cut round with probe-pointed scissors or a bistoury, and the condition of the arachnoid and pia mater noted.

(1.) The Brain.

Remove the brain carefully ;—Note the condition of its base and of the sinuses. This done, proceed to slice it from above. The principal appearances to look for are general congestion, extravasations (such as apoplectic clots), effusion of serum or of blood, lymph, and pus, hydatids, aneurism or blocking of vessels and tumors (malignant or simple).

Note therefore :—

(1.) The thickness of the bones of the skull and the extent of diploë.

(2.) Fractures: (Carefully follow the line and extent of all fractures.)

(3.) The condition of the dura mater (*i.e.*, whether adherent or firmly detached, congested, or diseased) and of the pia mater and arachnoid.

(4.) The consistence of the brain substance.

(5.) The color of the brain substance.

(6.) Whether serum be present or absent in the lateral ventricles and at the base.

(7.) Morbid growths or conditions: Distinguish between—
  (*a.*) Disease of blood-vessels (*e.g.*, atheroma leading to rupture and apoplectic hemorrhage), and
  (*b.*) Disease of the brain tissue.

Remove the dura mater, and examine the bones of the base and lateral portions of the skull for fractures.

(2.) Spinal Cord.

To examine *the spinal cord and its membranes*, the vertebral laminæ are to be sawn through on each side of the spinous processes, keeping as near to them as possible in order that the cord may not be injured during removal. This done, the cord is to be removed with the dura mater unopened. By drawing the finger along it, its increased or diminished resistance (which diminished resistance not unfrequently occurs in diseased conditions) can be appreciated. Sections are now to be made. After injuries, although nothing may be visible externally, nevertheless, on making longitudinal sections into the cord, hemorrhage may be found to have taken place in the gray matter.

All extravasations of blood, injuries to bones, intervertebral cartilages, etc., are to be recorded.

(B.) THE THORAX AND ABDOMEN.

In all ordinary cases, after the inspection of the head the thorax is to be examined, and then the abdomen.

In cases, however, where the cause of death is believed to be due to asphyxia, the advisability of examining the condition of the heart before opening the head has been already discussed (p. 252). It is scarcely possible to judge correctly the condition of the right side of the heart when the head has been opened first.

In new-born children, again, it is advisable to open the abdomen before the thorax. In such case proceed as follows:—

Make a long incision, and reflect *the skin only* from a little above the top of the sternum down to the pubes. This done, carefully reflect the muscles and integuments necessary to lay open the abdomen completely. Note if any fluid or gas escape. Note three things:—

(1.) *The position of the diaphragm* with reference to the corresponding ribs. (This must be determined with the hand.)

(2.) *The position of the abdominal organs.*

(3.) *The color of the abdominal organs.*

These three points being determined, the examination of the thorax is to be proceeded with.

[The object of *opening* the abdomen before the thorax in order to determine the position of the diaphragm (a matter of importance in deciding whether the child has or has not breathed) and the position and color of the abdominal organs, is because these points can only be determined accurately before the thorax is disturbed. For as the thoracic viscera are removed the diaphragm becomes loose, and as a consequence the abdominal viscera more or less displaced. Again, as regards the color of the abdominal viscera, it is well to note that it is impossible at a post-mortem in any case to distinguish between arterial injection and venous hyperæmia, all the blood in the dead body (save, perhaps, a little in the lungs) being of a dusky hue. By exposure, however, a certain absorption of oxygen results, with a brightening of the color tint. Hence a part affected with mere venous congestion may by exposure assume the appearance of arterial injection.

But, having noted these three things, we then proceed with the examination of the thorax, leaving the further examination of the abdominal organs until this part of the post-mortem is complete. If this be not done, the blood is certain, as the abdominal vessels are severed, to run out of the right auricle. If the examination of the heart be made after the examination of the abdomen, we should be almost certain to find it in a state of collapse, induced probably by our method of procedure.]

(C.) THE THORAX.

With the thumb on the back of the knife, and its edge lateralized, cut carefully through the sterno-clavicular ligaments and cartilages of the ribs. In very old people, or in cases where calcification of these cartilages has occurred, cutting pliers or a saw may have to be used. Note if blood flows freely from the cut integuments. Be very careful not to wound the large veins of the neck, etc. Reflect the sternum.

Record as follows:—

(*a.*) Are the lungs adherent?

(*b.*) Are they collapsed, or do they fill the chest, or (as in emphysema) do they project when the sternum is removed?

Now open the pericardium and pleural cavities:—

(*c.*) Record *immediately* the presence, the amount, and the nature (serous, sero-purulent, or purulent, etc.) of the contents of these sacs.

(*d.*) Record *immediately* the general position and color of the thoracic viscera.

[*Immediately.*—that is, before removing either heart or lungs, For not infrequently, in removing the sternum, certain large veins (such as the internal mammary, internal jugular, and innominate) are injured, and the blood finds its way into these sacs.]

(*e.*) Record if any tumors be found in the thorax.

(1.) The Heart.

Before removing or opening the heart, note:—

(*a.*) Its *size.*

(*b.*) The *fulness of the coronary vessels.*

Each auricle and ventricle of the heart is now to be opened while the heart is in situ. Note:—

(*c.*) The *contents of each cavity* (*i.e.*, the quantity of blood and the extent to which it is coagulated).

Remove the heart. Note:—

(*d.*) Its weight.

(*e.*) The condition of the tissues (*e.g.*, fatty degeneration, etc.).

[An examination of the tissue, if necessary, must be conducted microscopically.]

(*f.*) The thickness of the walls of the ventricles (hypertrophy).

(*g.*) The capacity and size of the valves.

(*h.*) The condition of the valves. [Look for tufts of fibrin on the edges of the valves (inflammation), atheromatous degeneration, etc.]

(2.) The Aorta.

Examine for:—

(*a.*) Atheroma.

(*b.*) Aneurism.

(3.) The Lungs.

Record:—

(*a.*) Color (Dark red, gray, black, etc.).

(*b.*) Nature of surface (Mottled, any signs of inflammatory exudation, etc.).

(*c.*) Capacity for air.

Long incisions are now to be made into the lungs. Note:—

(*d.*) The character of the lung-tissue generally (Dense, friable, indurated, carnified, crepitant, etc.).

(*e.*) The character of the fluid that exudes on pressure.

(*f.*) The condition of the bronchial tubes and pulmonary artery (? obstruction). [It may be necessary to follow these vessels by dividing them with scissors, even to their finer ramifications.]

(*g.*) The presence of foreign matter in the air-passages:—[For the purpose of determining the nature of this foreign matter the microscope may be needed.]

(*h.*) Pathological conditions.

The lungs in the case of new-born children are to be examined whether or not respiration has taken place. And this leads us to consider—

The appearances of the lungs before respiration has been established. These may be stated as follows:—

(*a.*) They do not nearly fill the chest nor cover the pericardium.

(*b.*) Their color is dark maroon, and no bright vermilion spots are visible on their surfaces. (For these spots search especially on the edges and the concave surface of the upper lobe of the right lung.)

(*c.*) The margins are sharp and well defined.

(*d.*) The lungs are dense, firm, and non-crepitant when incised.

(*e.*) When incisions are made in them under water, and they are submitted to pressure, no bubbles of air escape.

The Hydrostatic Test.

This test is to be conducted as follows:—

(α.) Remove the lungs and heart entire, securing all the larger vessels to prevent loss of blood. Note if they float when placed in water *en masse*, using for this purpose a *large* vessel, filled (by preference) with rain water.

(β.) Test each lung separately in a similar manner.

(γ.) Cut each lung into ten or twelve pieces, and note whether the separate portions sink or float.

(δ.) Each piece of lung is now to be wrapped in a cloth. The cloth is to be placed on the floor and covered over with a piece of board, and pressure applied by a person standing on the board for a few minutes. The several pieces, after this treatment, are again to be tested whether they sink or float.

[Conclusion.—If the lungs float by all four tests as described above, there is strong presumptive evidence in favor of respiration;—and conversely, if they sink there is strong presumptive evidence in favor of non-respiration.]

Note whether any morbid products (tubercle, etc.) or foreign substances (meconium, mucus, etc.) are present in the air-cells and passages.

(4.) The Thymus Gland.

(5.) Larynx and Trachea. Pharynx and Œsophagus.

Prolong the incision up to the chin, and reflect the skin as far back as possible. The knife is now to be plunged just under and below the symphysis of the jaw (so that it may *emerge in the mouth*), and carried along close to the inner surface of the lower jaw on each side as far as the bone extends. This done, seize the tongue from below, and divide the velum pendulum palati, dragging the tongue forward all the time. Then separate the pharynx, etc., and continue to make traction on the tongue till the pharynx, larynx, trachea, and œsophagus have been removed. Open the larynx and trachea, and also the bronchi if necessary, and look for foreign bodies, false membranes, marks of corrosion, etc.

If it be supposed that death has resulted from strangulation or suffocation, record :—

(*a.*) Whether there be any injury to the internal coats of the carotids. (For this purpose they must be carefully slit open.)

(*b.*) The condition (congestion, etc.) of the deep muscles of the neck.

(*c.*) The state of the cervical vetebræ.

In the case of children the condition of the œsophagus must be carefully noted.

(D.) THE ABDOMEN.

[Note carefully all signs of peritoneal inflammation, also all tumors, cancers, or enlargement of any of the organs.

It is advisable for cleanliness sake to leave the examination of the stomach and intestines until the other abdominal viscera have been examined.

Examine the various viscera in detail. If blood be found effused within the abdominal cavity, careful examination should be made for lacerations of the liver, spleen, kidneys, etc.

Carefully note if there be any strangulation of the intestines intussusceptions, internal herniæ, etc.]

(1.) The Liver.

Note:—

(*a.*) Its weight.

(*b.*) Its color and appearance on section, as follows:—

(1.) Normally, a uniform purple-brown.

(2.) *Nutmeg* (*i.e.*, some parts being dark purple and others buff color), indicating congestion.

(3.) *Cirrhosis.*—Dense and tough.—Surface irregular.

(4.) *Fatty.*—Soft and pale yellow.

(5.) *Amyloid* (lardaceous).—Smooth, enlarged and brown, with a glaze upon it.

(Note the presence of cancer, abscess, etc.)

(2.) The Kidneys.

Note:—

(*a.*) The weight of each.

(*b.*) Whether or not the capsules peel off readily.

(*c.*) Appearance on section, as follows:—

(1.) *Inflammation.*—Large, soft, and congested in the first stage, but paler in the after stage.

(2.) *Granular.*—Capsule adherent. Weight below the normal. Cortical structure diminished, but firm and tough. Perhaps cysts may be found under the capsules or in the tissue.

(3.) *Amyloid.*—Capsule easily detached. Viscus large, smooth, and glistening on section. (Changes to a violet-brown with tincture of iodine.)

[Note the presence of tubercle, abscess, cancer, etc.]

(3.) The Spleen.

Record:—

(*a.*) Its weight.

(*b.*) Its appearance on section.

(4.) The Bladder, Ureters, and Urethra.

Note the size of the prostate and the condition of the urethra.

[N.B.—Carefully preserve any urine in the bladder for chemical analysis.]

(5.) The Vagina, Uterus, and Ovaries.

[The vagina is to be examined before the uterus.]

(A.) *Vagina.*—Note its color, the presence of rugæ, the condition of the hymen, etc.

Record:—

(B.) *Uterus:*

(*a.*) Its size externally.

Open by an incision from fundus to cervix:—Note

(*b.*) Its size internally.

(*c.*) The condition of its mucous membrane and muscular tissue as follows:—

(1.) Normal.
(2.) Congested.
(3.) Covered with mucus.
(4.) Very dark colored (as after abortion).
(5.) Presence of decomposing tissues; remains of decidua, etc.
(6.) Tumors, cancer, etc.

(*d.*) Condition of the cervix as follows:—

(1.) Hypertrophied.
(2.) Ulcerated, etc.

(C.) *Ovaries.* Note:—

(*a.*) Their size.

(*b.*) Condition of the surfaces (Irregular, etc.).

Make a section of the ovary, and note as follows:—

(*c.*) The state of the Graafian vesicles.

(*d.*) The presence of true and false corpora lutea.

(*e.*) Diseased conditions. (These require accurate description.)

The condition of the ovaries and uterus in the case of females must be recorded with great minuteness. Young women sometimes die suddenly of apoplexy of the ovary, or of pelvic hæmatoceles.

Fatal injuries may be inflicted through the anus or vagina, and poisons have also been introduced through these channels. ("*Edin. Med. and Surgical Journal,*" Vol. XXXV., p. 85.)

If a fœtus be discovered, a careful examination must be instituted to determine its age. (Table II., page 271.)

In the case of a woman who has died in childbed, the condition, size, and contents of the veins and lymphatics in the walls and on the

inner surface of the uterus and its appendages, should be noted. Careful examination must also be made for marks of injuries on the mother or fœtus arising from instruments, whether used scientifically or otherwise.

(6.) The Stomach and Intestines.

(A.) *Stomach* :—

Place one ligature around the œsophageal end of the stomach, close to the diaphragm, and two ligatures around the first part of the duodenum. Remove the stomach, cutting between the two ligatures last tied.

Open the stomach carefully, and note the color, appearance, smell, and reaction of the contents. This done, they are then to be preserved in a clean bottle or jar for further examination. The inner surface of the stomach should be carefully examined with a lens for solid particles of phosphorus, arsenic, corrosive sublimate, and other poisons; also for seeds and portions of leaves, crystals, pigments, and articles of food. Careful note should be taken of the condition of the mucous membrane.

Note further the permeability or otherwise of the gall-duct, and the nature of any matters present in it.

The intestines should now be removed, a ligature being placed around the rectal end of the colon. They must be examined from end to end, and the contents (if necessary) preserved in a clean bottle.

(B.) *Intestines* :—

In examining the intestines note particularly :—

(*a.*) The condition of the agminate and solitary glands and of the villi and valvulæ conniventes.

(*b.*) The condition of the vermiform appendage.

(*c.*) Any loss of substance, ulcers or erosions.

The condition and contents of the rectum and the appearance presented by the anus, are to be accurately recorded.

The appearances (if such exist) indicating syphilis, tubercle, typhoid fever, etc., should be duly recorded. Ulcers and perforations must be most carefully described, both in respect of their position and appearance. We may remark that any person familiar with the post-mortem room can scarcely mistake the rounded and thickened edges of chronic ulcers for the thinned and frayed perforations caused by corrosive fluids

an irritant poisons. Great care should be taken not to cut or tear the organs in removing them.

Portions of the liver, of the heart (the preservation of which in certain cases, such as in strychnia poisoning, is of the utmost importance), and other organs, should be preserved for analysis if necessary.

All bottles, into which viscera are placed should be stoppered, sealed with a private seal, and duly labelled, the label stating the date of the death and of the autopsy, and the name of the deceased person. It should also be signed by the medical man that conducted the post-mortem. The bottles should be delivered personally by him, or at any rate by a responsible officer, to the chemist for analysis.

In any case that may specially call for it, some of the blood (taking care that it is as free from foreign matter as possible) should be preserved in a separate bottle for general, spectrum, and microscopic analysis.

Where trichinosis is suspected, portions of the muscular tissue of the diaphragm, and of the pectoral and the recti muscles of the eyeballs, should be carefully preserved for microscopical examination.

TABLE I.[1]

	Weight.		Measurements, Contents, etc.
	Male.	Female.	
Brain	49½ ozs.	44 ozs.	15 to 18 inches long.
Spinal Cord	1 oz. to 1½ oz.		
Thymus (at birth)	½ oz.		
Thyroid body	1 oz. to 2 ozs. (largest in females).		
Lungs, right	24 ozs. } = 45 ozs.	17 ozs. } = 32 ozs.	
Lungs, left	21 ozs.	15 ozs.	
Heart	9½ ozs.[2]	8¾ ozs.[2]	About the size of the closed fist (5 in. × 3½ in. × 2½ in.). Circumference 9.2 in. at widest part.
Orifices of the heart—			
Mitral	....	....	4 in. circumfer'ce.
Tricuspid	....	....	4½ in. "
Aortic	....	....	3⅙ in. "
Pulmonary	....	....	3½ in. "
Stomach	4½ ozs.	Slightly under 4½ ozs.	Length, 10 to 12 inches. Diameter at widest part when moderately full, 4 to 5 in.
Liver	50 to 60 ozs.	45 to 55 ozs.	12 in. × 4 in. × 2 in.
Spleen	5 ozs. to 7 ozs. (May vary even in health from 4 to 10 ozs.)		
Pancreas	2½ ozs. to 3½ ozs.		
Kidneys, right	4½ ozs.	3¾ ozs.	
Kidneys, left	5½ ozs.	5 ozs.	
Suprarenal capsules (each)	1 to 2 drachms.		
Ureters	....	....	Length, 14 to 16 inches.
Prostate gland	6 drachms.		
Testicles (together)	¾ oz. to 1 oz.		
Uterus (unimpregnated)	....	7 to 13 drachms.	3 in. × 2 in. × 1 in.
Ovaries (together)	....	120 to 200 grains.	
Bladder	....	....	Size subject to great variation. Probably rather greater in females than males.

[1] The weights are to be regarded as averages only.

[2] The weight of the heart bears a direct proportion to the weight of the body generally, and especially to the development of the muscular system. Thus a perfectly *normal heart* may weigh considerably more or considerably less than the weight stated.

TABLE II.

Appearance of the Fœtus at different Periods of Utero-Gestation.

	End of first month.	End of second month.	End of third month.	End of fourth month.	End of fifth month.	End of sixth month.	End of seventh month.	End of eighth month.	End of ninth month (full time).
Length......... Weight.........	3 to 5 lines. —	16 to 19 lines. 150 to 300 grains.	2 to 2½ inches. 480 to 720 grains.	5 to 6 inches. 2½ to 3 ounces.	6 to 7 inches. 5 to 7 ounces.	9 to 10 inches. 1 pound.	13 to 15 inches. 3 to 4 pounds.	14 to 16 inches. 4 to 5 pounds.	17 to 21 inches. 5 to 9 pounds (average weight 6.5 pounds).
Membrana pupillaris..........	—	—	Visible.	Present.	Present.	Present.	Beginning to disappear.	Has probably disappeared.	Entirely disappeared.
Hair	—	—	—	—	Begins to appear	Hair white or silvery.	Hair.	Hair.	Head more or less covered.
Nails...........	—	—	—	Begin to appear.	Very distinct.	Free border projecting from dermis visible.	Do not reach extremities of the fingers.	Reach extremities of the fingers.	Fully developed.
Development of genital organs.	—	Penis or clitoris visible.	Penis or clitoris very long.	Genital organs and sex distinct. Formation of scrotum and prepuce.	Commencement of limitation of the uterus and vagina.	Testes near the kidneys. Walls of the uterus thicken.	Testicles further off the kidneys than at the sixth month.	Testicles descend into internal ring.	Testes have passed inguinal ring, and are often to be found in the scrotum.
Points of ossification .... (See page 137.)	—	Fifth week— Clavicle. Lower jaw. Seventh week— Ribs, scapula, humerus. Femur and tibia. Palate and upper jaw. Eighth week— Frontal bone.	Occipital. Sphenoid. Squamous portion of the temporal.	Superior part of the sacrum and pubis.	—	Four divisions of the sternum visible.	Astragalus.	Last vertebra of sacrum. [*No centre of ossification in the cartilage of the inferior extremity of the femur.*]	
Other points to be noted......	Two black spots indicating eyes. Liver occupies the whole abdomen.	Rudiments of nose and lips. Placenta begins to assume a regular form.	Fingers begin to separate. Two ventricles of heart distinct. Eyelids in contact by their free margins.	—	Meconium in commencement of large intestines. Germs of permanent teeth appear.	Meconium in the large intestines. Skin assumes the appearance of fibrous structure.	Meconium occupies the whole of the large intestines. Eyelids no longer adherent. Bile in gall-bladder.	—	Meconium in rectum, or at least in sigmoid flexture. Eyelids open.

CHAPTER VI.

SEX.—MONSTROSITIES.—HERMAPHRODISM.

Sex.—The Male and Female Pelvis.—Monstrosities.—The Shape of Mankind.—Acardiac, Acephalous, Anencephalic, and other Monsters.—Redundancy of Genital Organs.—Euthanasia.—Hermaphrodism.—Homologous Organs in the Male and Female.—Varieties of Hermaphrodites.—Spurious and Real Hermaphrodism.—Androgynæ—Androgyni.—Sexless Beings.—Concealed Sex.—Conclusions.—Examination of Cases of Doubtful Sex.

ILLUSTRATIVE CASES, p. 294.

SEX.

IN cases where isolated bones or complete skeletons are submitted to the medical jurist to determine whether they belong to a male or female, it is important to remember that until puberty little difference is to be noted in the general characteristics of the sexes, although, age for age, male children have an undoubted advantage, both in height and weight, over female.

Omitting for the moment the examination of the pelvis, the following general distinctive characteristics of the skeletons, and individual bones of adult males and females, may be noted :—

In the male the shoulders are broader than the hips. The muscles being more developed, the bones usually present rougher and more prominent markings than those of the female. In hard-working women the bones, however, are often strongly marked. The male skeleton, as a rule, exceeds the female both in height and weight. (*See* Tables, pp. 145, 146, etc.)

In the female the hips are broader, the thighs shorter and bigger, and the tuberosities of the ischia and the acetabula wider apart. It is said that "the female *skull* is smaller, more ovoid, more bulging at the sides, and larger behind the foramen magnum than the male. The face is more oval, the frontal sinuses less strongly marked, the nostrils more delicate, the jaws and teeth smaller, and the chin less prominent. The *chest* of the female is deeper than that of the male [?], the *sternum* shorter and more convex; the ensiform cartilage thinner and os-

sified later in life; the ribs smaller, and the cartilages longer. The *vertebral column* is longer and the bodies of the vertebræ are deeper in the female than in the male." [Dr. Guy.] As regards the clavicles and scapulæ, and the bones of both upper and lower extremities, and particularly the hands, those of the female are *generally* smaller and lighter than those of the male.

It is scarcely possible, however, considering the close resemblance between the bones of men and those of hard-working women, to form a definite opinion as to the sex of the person of which they are a part from any one or two bones, unless we can examine the pelvis.

We must therefore now consider, as the most important question connected with the determination of sex,—

The differential characters of the male and female pelvis.

The *male* pelvis presents a narrow but deep excavation with small apertures. Its bones are thick, its muscular impressions well marked, its angles abrupt and prominent, whilst its general appearance is that of a strong framework, adapted to afford leverage to powerful muscles.

The *female* pelvis is not so deep as that of the male, but exceeds it considerably in its transverse and antero-posterior dimensions. Its cavity is more capacious, its apertures larger, its walls less massive and rough, whilst its general contour is less angular and abrupt. The alæ of the ossa innominata spread farther outward; the anterior superior spinous processes, and the tuberosities of the ischia and the acetabula (whence the prominence of the hip of the female) being removed to a greater distance from the median line. The sacrum is wider and less curved, and consequently the sacro-vertebral angle is less prominent than in the male. The obturator (or thyroid) foramen is somewhat triangular in form, and of a smaller size than in the male;—the ischiatic spines project less into the pelvic excavation;—the coccyx is more movable,[1] and the symphysis pubis less deep. The upper aperture is more nearly circular and its margin smoother and more rounded. The pubic arch is wider and more curved, and its rami are everted so as to present shelving surfaces (rather than angular edges) to any object descending through the perineal strait. By these several peculiarities of form and structure, the female pelvis is adapted to permit the expan-

[1] During the last months of gestation the joints of the female pelvis acquire an increased mobility This change is at first temporary, but after frequent child-bearing becomes permanent. The coccyx is sometimes anchylosed to the sacrum by bony union, and may become fractured during childbirth.

sion of the uterus during pregnancy, and the passage of the child in parturition.

The general measurements of the male and female pelvis may be stated as follows :—

	Male.		Female.				
	Inches.	Lines.	Inches.	Lines.		Inches.	Lines.
Between the antero-superior spinous processes of the ilia..	7	8	8	6	to	10	0
Between the middle points of the cristæ of the ilia.......	8	3	9	4	to	11	1
The transverse ..... diameter of the abdominal strait of the true pelvis.	4	6	5	0	to	5	6
" oblique........ diameter of the abdominal strait of the true pelvis.	4	5	4	5	to	5	5
" antero-posterior diameter of the abdominal strait of the true pelvis.	4	0	4	0	to	4	4
The transverse ..... diameter of the cavity of the true pelvis.	4	0	4	7	to	4	8
" oblique........ diameter of the cavity of the true pelvis.	5	0	5	2	to	5	4
" antero-posterior diameter of the cavity of the true pelvis.	5	0	4	7	to	4	8
The transverse ..... diameter of the perineal strait of the true pelvis.	3	0	4	0	to	4	5
" antero-posterior diameter of the perineal strait of the true pelvis.	3	3	4	4	to	5	0

If mutilated portions of a body not skeletonized be presented for report, certain further peculiarities must be recorded :—

(*a.*) If the *genital organs* be found, there will be no difficulty in determining sex, unless in cases where the sex is doubtful, with which cases we shall afterward deal in detail.

(*b.*) *The breasts* of the female are, as a rule, more developed than those of the male. There are many instances, however, of male breasts being very large, whilst some women have scarcely any development of mammary glandular tissue. (*Case* 136.) (See a series of cases of developed breasts in males in a paper in the " *Lancet*," March 14, 1874, on " Abnormalities in 25,000 Recruits.")

(*c.*) *The hair and position of the umbilicus.* The pubic hairs of the male extend higher toward the umbilicus than those of the female. The distance in males between the pubes and the navel is shorter than between the navel and the scrobiculus cordis, the reverse being the case in females. (Dr. Handyside.) The male has more hair on the body, but less and shorter hair on the head.

(*d.*) Other distinctive peculiarities to be noted are (1.) That in the male the pomum Adami is more developed than in the female, and the larynx larger. (2.) That the average male head is larger, and the brain heavier. (3.) That the blood of males is said to be richer in red corpuscles than that of females.

One other point, *re sex*, is worthy of repetition here. It is well

known that the uterus resists decomposition after death in a remarkable manner. In fact, it may be found comparatively fresh when recognition of all the other organs has become impossible from decomposition (see p. 92).

MONSTROSITIES:—HERMAPHRODISM.

Exceptional cases occur where the subject of monstrosity and the determination of sex become questions of the gravest difficulty to the medical jurist, and of the most supreme importance to relatives and friends.

If a child be born without "the shape of mankind," he cannot inherit. The law, however, does not define the phrase "shape of mankind," but it is certain that it implies far more than mere bodily deformity. The question therefore becomes one of great importance, *viz.*, what degree of monstrosity or unshapeliness must exist to prevent legal rights? In a case of this nature, the duty of the medical jurist would in our judgment be best performed by describing with the greatest detailed accuracy in what respect the individual in question differs from the normal, leaving the Court to say whether it be "without the shape of mankind or not."

Supposing, however, that it be proved to the satisfaction of the Court that the individual in question is possessed of "the shape of mankind," and therefore capable of inheriting, the further question arises, "Is it male or female, or both in one (hermaphroditic)?"

Thus when a title or entailed inheritance of land is in question, the sex as well as the capability to inherit, must be determined. Thus, an estate may be settled on heirs (male or female) of a particular family limited by entailment. If only one child be born, and that hermaphroditic, it will then be necessary to decide "the sex that doth prevail," for "according to the sex that doth prevail, so will it succeed." Or, perhaps two children may be born, the first being hermaphroditic, and the second a well-formed male. On the death of the father, the question arises, as to which shall succeed to the title; because if the first-born (*i. e.*, the hermaphrodite) have male peculiarities prevailing over the female, he succeeds to the title, but if the female peculiarities prevail over the male, then the next born, being a male, succeeds.

Again, the sex of a child may be important with respect to its future business or profession. For instance, a girl cannot be admitted to holy orders.

Again, the live birth, even for a few seconds, of a living child of a certain sex, may be important in cases of "Tenancy by courtesy." Hence the accoucheur should always note the sex of the child he has assisted to bring into the world.

Again, in questions of divorce (the plea being a sound one) it may be urged by a husband that his supposed wife, or by a wife that her supposed husband, is so constituted as to be anatomically incapable of acting in his or her proper sexual relationship. Marriage is a contract, and a contract is void unless both parties to the contract are capable and willing to fulfil its provisions. Thus as early as 1654 a divorce was granted because the wife was a reputed hermaphrodite. ("*Edin. Med. Journ.*," Vol. XII., p. 767.)

And again, where questions of legitimacy and paternity concern hermaphroditic individuals, a third question presents itself to the medical jurist, *viz.*, whether a being of this nature, admitting that "a certain sex doth prevail," be it male or female, is capable of procreating its kind?

A still further difficulty may occur. The law is that an hermaphrodite succeeds "according to the kind of sex which doth prevail." But supposing neither sex prevails? And of such sexless beings we have recorded instances.

It will be seen, therefore, that the subject of monstrosity and hermaphrodism practically resolves itself into the three following questions:—

1. Has this monster the shape of mankind or not?
2. Is it male or female, or a mixture of the sexes?
3. If male or female, is it capable of procreating its kind?

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1. Has this Monster the Shape of Mankind or not?

Deformities[1] may be considered under three heads:—

(A.) *Acquired deformities and diseased growths.*

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[1] Consult on these subjects Geoffrey St. Hilaire, "Histoire générale et particulière des Anomalies de l'Organisation chez l'Homme et les Animaux." Förster, "Die Missbildungen des Menschen." Sir James Simpson's Article on Hermaphrodism in Todd's "Cyclopædia of Anat. and Phys." Vrolik in 4th vol. "Cyclopædia of Anatomy," and also his "Vrucht van den Mensch en ven de Zoogdieren." Dr. Allen Thompson on Double Monsters, "London and Edinburgh Monthly Journal," 1844. B. T. Lowne, "Descriptive Catalogue of the Teratological Series in the Museum of the Royal Coll. Surgeons of England, 1872," and the "Edinburgh Medical Journal," and other medical periodicals for the last half century (British and Foreign).

This class need not detain us, since deformities of this nature are not likely to become matters of legal inquiry, except in questions of divorce where they interfere with sexual connection.

(B.) *Congenital deformities arising from a deficiency of structure, with arrested or defective development of parts.*

Of these we may consider the following:—

(α.) *Acardiac monsters* (without a heart). (*Cases* 1 and 2.)

An acardiac fœtus is always one of a twin birth, the other child—so far, at least, as the heart is concerned—being perfectly developed. At birth the acardiac fœtus it is true may show signs of maturity, but it is also certain that the circulation during intra-uterine life must have been maintained by the heart of the normal fœtus. ("*British Med. Jour.*," Aug. 23, 1879, p. 303. "*Edin. Med. Jour.*," XXIII., p. 46 [Professor Simpson]. See Dr. Ogle's paper on the Circulation in the Acardiac Fœtus, "*British Med. Jour.*," Oct. 28, 1871, p. 490. "*British Med. Jour.*," July 20, 1871, p. 525 [Dr. Johnson]. See also a reference to the alleged Viability of an Acardiac Fœtus in the "*British Med. Jour.*," June 3, 1871, p. 598.) It follows, therefore, that the acardiac fœtus, cannot have an independent existence. Such monsters are, consequently, not likely to become subjects of legal inquiry, either civil or criminal.

(β.) *Acephalous monsters* (without a head). (*Cases* 3 to 7.)

In none of the recorded cases of headless monsters was any sign of life exhibited. Hence, in such cases litigation is scarcely likely to occur.

In *Cases* 8 and 9 two illustrations are recorded of microcephalic children. Both were born alive, but seem to have been idiotic and ape-like in their characters. It would be impossible, however, to deny such beings human shape.

(γ.) *Anencephalic monsters* (without a brain.) (*Cases* 10 to 24.)

In these cases, the forehead, cranial vault, and brain are entirely wanting. Sometimes the child seems well developed (*Cases* 10, 11, 20, etc.), but more often other deformities exist. For example, the entire spinal cord may be wanting (*Case* 17), whilst at other times the medulla oblongata and cerebellum may exist without a trace of cerebrum (*Case* 11). Some anencephalic children seem at birth to be well matured (*Cases* 10, 13, 18). The important fact, however, is that such children may be born alive. Thus, in *Case* 16 the child was recorded as living when two months' old, and in *Cases* 10, 22, and 24, periods of more or less active life of 1½ hour and under are mentioned.

(δ.) *Cases* 25 to 38 represent deformities the result of structural de-

ficiency of various kinds, such as the absence of arms, nose, one or both eyes, ears, etc.

(C.) *Congenital deformities arising from a redundancy of parts, or from the union of two or more embryos.*

Children born with supernumerary toes, fingers, and nipples (all of which characteristics may prove of the utmost importance in establishing identity) need scarcely detain us in considering the medico-legal aspects of monstrosity. Under this heading, however, we have to consider cases of

DOUBLE MONSTERS.

Of double monsters we have two distinct classes:—

(1.) *Where the children are more or less distinct above and below.*

The parts united in these cases vary, but the following are those in which union most frequently occur:—

(α.) Union by a band of greater or less width extending from the thorax and abdomen of one child to the thorax and abdomen of the other. (*Cases* 50 to 58.)

(β.) Union in the back and pelvis. (*Cases* 59 to 64.)

(γ.) Union of the heads and scalps. (*Case* 65.)

In all these cases the invariable teratological law holds good, that the parts of one child are conjoined to the same parts of the other child—bone to bone, muscle to muscle, organ to organ. Exceptions, however, occur in the case of dwarfed parasitical twins. (See "*British Med. Jour.*," 1869, I., p. 231.)

(2.) *Where the union of the twins is deep and intimate, and more or less complete.*

Of this class there are three subdivisions:

(α.) Where the children are single above and double below. (*Cases* 66 to 74.)

(β.) Where the children are double above and single below. (*Cases* 75 to 83.)

(γ.) Where the bodies of the two children are so connected that they form a single body, with a head at each end. (*Case* 84.)

Having now briefly referred to the various classes and sub-classes of so-called monsters, we are in a position to discuss the medico-legal aspects of monstrosity.

(1.) *What is implied by the phrase, "not possessing the shape of mankind?"*

A consideration of the recorded cases and of the specimens in our museums justifies the assertion that none of the so-called human monsters *that have lived to adult age* can be denied human shape. This, however, can scarcely be so positively stated in the case of certain human births where there has been distinct evidence of life for a brief period only. (*Case* 37.) Still, it would in our judgment constitute an almost unrecorded case where the jurist would be justified in saying without reserve that a child born alive had not the shape of mankind, implying as the phrase does far more than mere deformity. Hideous as the appearance presented by anencephalic monsters is (*Cases* 10, etc.), curious as are the so-called human syrens or dolphins (that is, children where the lower legs are completely united—*Cases* 35 and 36), and inhuman-looking as certain microcephalic (ape-like) and pig-faced children may appear (*Cases* 8, 9, 38), the medical jurist should, even in such cases, hesitate before he asserts positively that they lack human shape. We repeat that in such births, involving questions of law, it is better for the medical witness to describe to the Court the exact deformity, and leave the responsibility of deciding whether it be a monster in the true legal sense to others.

(2.) The law knows no such principle as that involved in the term "*Euthanasia*." The words of Mr. Justice Hawkins (R. *v.* Paine, tried for the murder of Miss Maclean, C. C. C., 1880) are on this point explicit: "It is equally criminal to accelerate by one hour the death of a person as to cause it." No degree of monstrosity or unshapeliness sanctions the destruction of life born of woman, either by medical attendant or friend. This question of monstrosity, therefore, does not arise in criminal cases (as in trials for infanticide, abortion, etc.), but in civil actions only. It is true that in a French case for child-murder, the prisoner was acquitted because the fœtus was acephalous (?) ("*Brit. and For. Med. Rev.*," Vol. XXIV., p. 563), but no such case is recorded in the practice of our English courts.

And again we doubt in cases where a certain blending of the sexes occurs, whether operative interference on the part of the surgeon could be justified. Thus, to remove two imperfectly formed testes in a girl-like boy, in order to develop more completely, as the child grew up, the girl-like character (however successful the operation), would not be easy to defend. (*Case* 105.) (See "*American Jour. Med. Sciences*," Oct., 1852.)

(3.) A further medico-legal question may arise in certain cases where the birth has been unusual, of which *Case* 15 is an illustration. A child was exhumed, and from the appearance of the head was believed to have come to its death unfairly. It was proved, however,

to be anencephalic, a condition that might easily give rise to a suspicion of violent treatment. In such case, however, it must not be hastily assumed that the anencephalic monster has *not* come to its death unfairly (seeing that such children are not unfrequently born alive), considering the horror that such a birth is likely to arouse in the minds of the parents and friends. The secret burial of such a child would, moreover, rather promote than allay the suspicion of foul play. On the other hand, some allowance must be made in all such cases for the natural desire of privacy, sufficient to account for the secret interment of such progeny without any criminal violence having been committed.

(4.) And here a further question arises, viz., how far is the division of united twins a justifiable operation? It is certain that there is in most of these cases independent action. (*Cases* 52, 53, 60, 61, 67, 77.) Two cases of successful surgical interference are recorded —the one operated on by Dr. Boehm ("*British Med. Journ.*," March 13, 1869, p. 229), and the other by Kœnig ("*British Med. Journ.*," Feb. 13, 1869, p. 141). Still it is open to grave question, in the event of such an operation ending fatally, how far the surgeon might not be placed in a difficult position. If, however, one of the children die, operative interference may then be called for, although prudence would suggest that the surgeon should not undertake the task of separation on his individual responsibility.

2. Is the Monster Male or Female, or Both in One (Hermaphroditic)?

And here it is to be noted that the differentiation of the sexual organs does not begin until a certain period after conception. Early in the existence of the fœtus, the cloaca divides, the posterior division becoming the outlet of the alimentary canal, and the anterior the genital fissure. In the female the anterior fissure remains fissured, and constitutes the labia externa or majora. In the male coalescence takes place, whereby the scrotum is formed for the reception of the testicles. From the front of the fissure a bud-like furrowed projection forms, developing into a penis in the male, and into a clitoris in the female. About the fourteenth week the margins of the furrow of this projection unite in the male to form the urethra, while in the female the lower surface merely remains grooved, the non-coalescent margins constituting the labia minora. In that abnormal condition occurring exceptionally in the male known as *hypospadias*, the margins *of this* fissure remain non-coalescent. Hence the urethra in such

cases is deficient, and a condition simulating feminine development results. Further, in hypospadias the cloaca as a rule remains ununited and the penis small and undeveloped, rendering it clitoris-like in character, the bulb being represented by two folds like labia minora. With all this, the internal organs are male (transverse hermaphrodism). Sometimes, moreover, a cul-de-sac (simulating the vestibule of the female) exists between these representatives of the labia minora, apparently made to meet a vagina which is absent.

In the female occasionally, nevertheless very rarely, certain canals passing from an ovary to an enlarged clitoris, have been found, representing the vasa deferentia of the male. These canals are persistent Wolffian ducts, which, although present in the embryos of both sexes, physiologically belong to the male, for in the male sex only are they, as a rule, developed. In the female these ducts usually disappear altogether. (See Watson's paper, in the "*Journal of Anatomy and Physiol.*," Vol. XIV., October, 1879, p. 50.)

In the male, on the other hand, the "sinus pocularis" is the homologue of the uterus. Thus, in exceptional cases, an organ resembling a uterus, or sometimes both uterus and vagina, is found in the male occupying the place of the sinus pocularis. ("*Cyclop. of Anatomy*," Art. Hermaphrodism. Scanzoni, "*Beiträge zur Geburtskunde*," iv., p. 25.) These formations are developed Müllerian ducts, embryonic structures, destined to become the vagina, uterus, and Fallopian tubes of the female, but in the male under ordinary circumstances to disappear, save as mere remnants of embryonic life without special function. (*Case* 47.)

Thus male and female, as it were, start together with Wolffian and Müllerian ducts and with divided cloaca, the sex depending on the turn that takes place in the after-development. There are, it is evident, therefore, in both male and female certain analogous and homologous parts. To complete what we have said as introductory to the subject of hermaphrodism, a tabular statement, in which such homologous parts are arranged as far as possible opposite one another may be advisable:—

I. External, or so called non-essential organs:—

MALE.	FEMALE
Mammæ.	*Mammæ.*
Penis.	*Clitoris.*
Spongy portion of urethra.	*Urethra.*
Scrotum.	*Labia majora and minora.*

II. Middle, and more essential organs:—

MALE.	FEMALE.
Cowper's glands.	Duvernay's or Bartholini's glands.
Membranous and spongy portion of urethra.	
Sinus pocularis.	*Vagina, with body and cervix of uterus.*
Vasa deferentia, ejaculatory ducts, and vesiculæ seminales from Wolffian bodies.	
Epididymis.	*Par-ovarium* or organ of Rosenmüller.
Hydatid of Morgagni.	Fallopian tubes and upper portion of uterus from Müller's ducts.
Gubernaculum testis.	Round ligament of uterus.

III. Internal, or essential organs:—

MALE.	FEMALE.
Testes.	*Ovaria.*

[For paper on the homology of male and female organs, see "*Lond. Med. Rec.*," Nov. 17, 1879, p. 429. See also a review of Ord and Rémy's paper on "The Homology of the Sexual Organs," "*Journal of Anatomy and Physiology*," Vol. XIV., p. 50, Oct., 1879), and the "*L. M. R.*," Dec. 15, 1879, p. 478.]

Having seen that the parts in the male may by an arrest of development simulate those of the female (*Case* 90), and that those of the female may, by excessive development simulate those of the male (*Case* 120), it follows as an important question, What is to be regarded as *the* distinctive sexual characteristic? To this there can be but one answer, and that is the *genital gland.* This is *the* reliable—and, we may add, the *only* reliable—test of sex. If the genital glands be testicles we must regard the individual as a male; and if, on the contrary, the genital glands be ovaries we must regard the individual as a female, independently in either case of anatomical conditions or characteristics. Nor are two testicles or two ovaries necessary. Given one testicle, no matter how imperfect or blended the genitals, or given one ovary, even if there be an absence of uterus or other sexual organs, the nature of the single gland must be accepted histologically as the test of sex. But to determine during life the coexistence of distinctive genital glands, or even to differentiate the genital glands, is, to say

the least, always difficult. The testicles may not have descended, whilst the ovaries even under normal conditions (at any rate, so far as accurate observation is concerned) are out of reach. Hence although the nature of the genital gland is the true groundwork for a definite opinion, and as such not to be forgotten, it is manifest that it would be impossible during life to limit our observations to, or even to form our opinions in all instances upon, this alone. The case is different in the post-mortem room.

The true definition of an Hermaphrodite[1] is *the coexistence in a single individual of completely developed ovaries and testicles, or of one at least of each gland.* It is scarcely open to question that, in the strict sense, a true human hermaphrodite has never existed, more especially if we regard as essential that the individual shall be able to perform the functions of either sex indifferently and effect self-impregnation.

But in the less strict sense, in which we commonly use the word hermaphrodism, viz., to imply the coexistence in a single individual of certain of the genital organs, or the blending of the sexual characteristics and instincts of both male and female, we have abundant illustrations. Thus we may have beings where the male organs and male instincts preponderate, although certain peculiarities or anatomical conditions peculiar to the female present themselves. On the contrary, we may have beings where the female genitals are predominant, although certain of the male organs with the proclivities of the sex are also to be found. And of these two classes the degrees of admixture are endless. (See *Illustrative Cases.*)

Such "a meeting of the sexes" occurs in plant and animal life generally. In the vegetable world it is the rule for male and female organs (stamens and pistils) to be united in the same flower, whilst in the lower forms of animal life this union of the sexes is not infrequent. Thus every mature joint of a tape-worn possesses both male and female organs of generation, internal as well as external. The same is true of slugs, snails, and many other molluscs, and of animals included in Cuvier's Radiata and Articulata. And even when we come to vertebrate animals we get occasional mixtures of the sexual characters, although less frequently as we ascend the scale of life. Thus when a cow has twins, apparently of opposite sexes, the bull-calf is generally perfect, but the cow-calf never propagates its kind, appears to have no sexual instincts, grows larger than either bull or cow, and fattens better. To such the name of *Freemartins* is given. Some of these

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[1] From Hermaphroditus, a person said to have been endowed with male and female powers.

have testes in lieu of ovaria, but occasionally both testes and ovaria appear to be present. The rest of the organs of these animals present a mixture of the characters of both sexes. ["*John Hunter's Works*," Vol. IV., pp. 41, 42.] In Vol. XLII. of the "*Medico-Chirurgical Transactions*," Mr. W. S. Savory describes and figures an hermaphrodite sheep, which was regarded during life as a ewe. The external orifice led into a vagina three inches long, beyond which was a two-horned uterus, two-thirds the usual size. In place of the ovaries were two testes, each surmounted by a small epididymis.[1]

Regarding hermaphrodism, therefore, in the less strict sense we have indicated, we may consider the subject, for purposes of convenience, under the following divisions:—

Class A.—Spurious Hermaphrodism.

(*In this class no anatomical admixture of the sexes occurs.*)

Subdivisions.—(1.) Manly women (Androgynæ).
(2.) Womanly men (Androgyni, Gynandri).

Class B.—True Hermaphrodism.

(*In this class the coexistence of certain of the genital organs and the characters of both sexes more or less prevail.*)

Subdivisions.—(1.) Cases where the male organs are more or less developed on one side of the mesial line, and the female organs on the other. (*Lateral hermaphrodism.*)
(2.) Cases where the external organs indicate the one sex and the internal organs the opposite. (*Transverse hermaphrodism.*)
(3.) Cases where two ovaries and two testicles, or other combinations of the generative organs of the male and female coexist in the same individual. (*Vertical or double hermaphrodism.*)

[1] These strange beings are well described by Ausonius in these words—

"Nominis ut misti, sic corporis hermaphroditus,
Concretus sexu, sed non perfectus utroque,
Ambiguæ veneris, neutro potiundus amori."

And by Ovid:—

"Nec duo sunt, sed forma duplex, nec femina dici,
Nec puer ut possit, neutrumque et utrumque videtur."

CLASS A.—SPURIOUS HERMAPHRODISM.

Cases of spurious hermaphrodism present no real difficulties to the medical jurist.

(1.) **Manly Women** (Androgynæ).

In some cases the growth of the hair and the development of beard, whiskers, and mustache may suggest a question as to sex. Such a freak of nature, however, is consistent with perfect womanliness, as in the case of Julia Pastrana. (See *Case* 119.) In the insane, and in old women, more especially in those where a certain degree of uterine absorption has taken place, and who have been unaccustomed to sexual intercourse since the change of life, such hirsute appendages are far from infrequent. ("*Lancet*," Jan. 25, 1873, p. 130.) *Per se*, therefore, excessive hair development has no real importance in determining sex.

Still it is unquestionable that in many cases where a certain manliness of the feminine character and instincts exist, combined with genital irregularities, such a development of hair constitutes one of the data upon which to base our decision as to sex. Thus, in *Case* 120, the growth of hair coexisted with certain other peculiarities that rendered the sex undefined.

We have now to consider some of the anatomical conditions which in the female may suggest a doubt as to sex:—

(*a*.) In most cases where females have been mistaken for males, *the enlarged clitoris* is the prominent feature. (*Cases* 49, 109, 110, 115 to 118, 120, 124, 130, 133.) This condition, uncomplicated with other malformations, such as adhesion of the labia and prolongation of the urethra, can scarcely constitute a real difficulty. It would appear that in the tropics, an enlarged clitoris is of more common occurrence than it is in temperate climates. Frequently, but by no means necessarily, such increased development is the result of libidinous practices.

It is important to note the points of dissimilarity between an enlarged clitoris and a penis. The absence in the clitoris of the corpus spongiosum is the first distinguishing feature. Further, the clitoris is an imperforate organ, although exceptional cases are recorded where a female is said to have menstruated through an opening in it. (*Case* 112.) Neither, however, can the imperforate condition of the organ, nor the uncovered state of the glans, nor the hoodlike preputium clitoridis, be relied on as distinctive of the clitoris, because we meet with practically identical appearances in the penes of hypospadians. In addition to which the urethra in such cases also terminates anteriorly to

the gland, in some instances grooving the under surface of the penis, a state of parts found by no means unfrequently in the clitoris. (See *Cases* 109, 117.) It is evident, therefore, that in considering whether the organ in question be a penis or an enlarged clitoris, general considerations, rather than special anatomical conditions, must constitute the data upon which our opinion should be based.

(*b.*) *Prolapsus procidentia of the uterus.* (See *Case* 121.) This condition could scarcely deceive a medical man.

(*c.*) *The loss of one or both ovaries.* This may produce a more or less manly appearance, a certain change of voice, etc.

(*d.*) *The absence or non-development of the uterus or of the ovaries, or of both.* There are several cases on record in which no trace of either uterus or ovaries could be found, and we have ourselves seen such cases. (*Cases* 104, 133.)

(*e.*) *Prolapse of the ovaries may simulate testes.* This was originally suggested by Velpeau. (See "*Lancet,*" Vol IX., p. 169.)

(2.) **Womanly Men** (Androgyni).

These cases are commonly more obscure and difficult than the former. We shall consider in the first place:—

(*a.*) *Cases of delayed manhood.* There is a class of cases where the disposition of parts proves beyond a doubt the male character of the individual, while there is nothing anatomically to indicate a mixture of the sexes. Nevertheless, the genital organs may remain of very small size, the boyish voice continuing, and neither face nor genitals exhibiting any appearance of hair growth with advancing age. A smooth plumpness and softness of skin and muscular development, a womanly nervousness, and the absence of sexual instincts or desires, may raise doubts, more especially if married, whether the individual be normal. This condition may last through life, whilst at other times a sudden manly development takes place. (*Case* 85.)

It is to be remarked that in some of these cases the power of coitus, and even of prolific coitus, has been proved to exist.

(*b.*) Again, *mere adhesion of the penis may deceive parents.* Mr. Brand, in 1779, operated on such a case in a boy of seven, who, until then, had been regarded as a girl. (Brewster's "*Edin. Encyclopædia,*" Art. Hermaphrodites.) It has been said that a similar *liberation* has occurred to the male organ of a supposed girl from the effect of jumping! Such cases are related by Livy, Shenkius, Montaigne ("*Essais,*" I., 20), and Ambrose Paré (case of Marie Germain).

(*c.*) *The entire absence of a penis, or the presence of a rudimentary penis only,* may prove causes of doubt. (*Cases* 27, 34.)

(*d.*) A very feminine appearance may result *from non-descent of*

the testes (or even of a testis), more especially if atrophy of the organ has taken place (*Case* 97). Early castration may produce similar results. Of course a careful examination would at once dispel in such cases any idea of hermaphrodism, because, although there may be no testicles, and possibly an ill-developed penis, sufficient indications of sex would be certain to be discovered. (*Cases* 88, 90, 93, 100, 108, 124.)

At the same time it is to be observed that where the Turkish method of making eunuchs be adopted (viz., by making a clean sweep of the genital organs), a hasty inspection of the parts might lead to a wrong conclusion as to the sex of the individual.

CLASS B.—TRUE HERMAPHRODISM.

By true hermaphrodism is implied the coexistence of certain of the genital organs, and a blending of the anatomical peculiarities of the two sexes, in a single individual.

Here the difficulties of classification specially present themselves, the subdivisions merely indicating for the most part the existence of an extreme degree of genital deformity of one kind over other genital deformities. The lines of demarcation are, however, far from being well marked.

The class of so-called true hermaphrodites may be considered under three subdivisions:—

(1.) *Cases where male organs (especially a testicle) are more or less developed on one side, and female organs (and especially an ovary) on the opposite side.* (Lateral Hermaphrodism.)

Case 130 (where the general configuration was masculine), *Cases* 125, 128, and 129 (where the general configuration was feminine), and *Case* 126 (where the general configuration was of a mixed character), supply illustrations of lateral hermaphrodism.

Thus a testicle with its vessels and other male organs may be found on the left side, and an ovary with its vessels and other female organs on the right side (*Cases* 125, 126, and 129) or *vice versâ* (*Case* 128). In some cases of lateral hermaphrodism, spermatozoa have been found in the seminal fluid, whilst in others a periodic menstrual discharge has been recorded (*Case* 125), such conditions at once indicating the prevailing sex. In *Case* 109, however, not only were spermatozoa discovered in the secretion of the testicle. but regular menstruation from the age of ten was said to have occurred. The case is complicated, moreover, by the existence of double sexual instincts.

(2.) *Cases where the external organs indicate the one sex, and the internal the opposite.* (Transverse hermaphrodism.)

Thus we have recorded instances where the external organs of generation resembled the male, and the internal the female. (*Cases* 111, 115 to 118, 120, 123, 124, 127, 137.) The enlarged clitoris in most of these cases seems to have been the principal cause of the masculine appearance, for internal organs left no doubt of the individuals being females. It is worth remarking that in a case on record two children born consecutively of one mother possessed this peculiarity. (*Case* 116.)

Again, the external organs may resemble the female, and the internal the male. Many instances of this kind where doubt has arisen as to sex have been cases of hypospadias, the anatomical characteristics of which have already been described in detail. (Page 281.) (*Cases* 85 to 103, 107, 114.) The prominent feature of a hypospadiac is (as we have said) a cleft scrotum, a small imperforate penis, the opening of the urethra being underneath. Various other conditions, however, are recorded. Thus sometimes each half of the scrotum contains a testicle. (*Cases* 86, and 101 to 103.) At other times, and most commonly, a testicle is found on one side only (*Cases* 85, 87, 88, 91, 93, and 94), whilst occasionally no solid body can be detected on either side of the cleft scrotum, the testicles being retained in the groin or abdomen. (*Case* 92.)

These cases constitute a source of great trouble to friends. In many instances the children are named, baptized, and brought up as girls, years passing by before the mistake is discovered. In many cases (*Cases* 85, 87, 99, 100, and 103) it would seem that the fact becomes apparent when the child is about 15 or 16, not unfrequently from the descent of one of the testicles causing a lump in the groin (*Cases* 87 and 101). But there are cases where the error remains uncorrected for a longer period. Thus in *Cases* 89 and 90 the individuals were 26 and 33 respectively before the true sex was discovered. And more remarkable still is *Case* 102, where a person at 60, who had all his life passed and even been married as a female, possessed well-formed testicles, a true vas deferens and vesiculæ seminales.

That in many of these cases there is a certain blending of the sexes is certain, although, at the same time, much allowance in this respect must be made for education and associations. In *Case* 91, for instance, it is stated that the hypospadiac had menstruated, had well-developed breasts, and was of feminine appearance. (See *Case* 103.)

It would seem that cases of hypospadians are amenable to surgical treatment. (*Cases* 95, 96, and 98.) (See "*British Medical Journal*," *Oct. 4, 1879*, p. 554.)

Cases of *epispadias* (*i.e.*, where the glans is split on the top, the bladder also as a rule being divided), need not detain us. It may be well to note that Professor Billroth states that he has seen two cases of double clitoris in female epispadians, both combined with prolapsus vesicæ. ("*Medical Times and Gazette*," March 12, 1870, p. 278.) (*Cases* 134 and 135.)

3. *Cases of complex hermaphrodism* (Vertical or Double Hermaphrodism).

This division comprises the many cases not included under lateral and transverse hermaphrodism. In certain rare instances (1) ovaries are associated with both male and female passages. In other also very rare cases (2) testicles are similarly associated (*Case* 111), whilst in a third subdivision (3) both ovaries and testicles coexist in the same individual. (*Cases* 112, 113, and 126 to 130.)

In *Cases* 109 and 113 periodic menstruation and a seminal secretion containing spermatozoa are recorded as occurring in each case.

It is neither easy, nor as a rule necessary, for the purpose of the medical jurist, to classify the cases of doubtful sex. It may be taken as a general fact that external malformation invariably indicates some internal defect or irregularity.

Sexless Beings.—Individuals are occasionally found presenting precisely opposite characters to that of hermaphrodites—namely, beings that have the essential features of neither males nor females:—in other words, where neither sex doth prevail. Of such individuals *Cases* 131 and 132 present illustrations.

In *Case* 40 the sex of a living child was doubtful, both penis and vagina being absent. In *Cases* 39 and 41, where there was an entire absence of the lower part of the abdomen, it was impossible to form any opinion of the sex of children born apparently at full term. In *Cases* 35, 42, and 46, the genital organs were said to be wanting in children live-born. *Cases* 43, 44 (where again the genital organs were absent), and 45, are also illustrations of almost sexless individuals.

Again, cases are recorded where, although there may be no admixture of the generative systems, a considerable difficulty arises from a want of completeness in the sexual organs. Thus in *Case* 48, the sexual desires were distinct, a vicarious menstruation occurred, vagina and ovaries were present, nevertheless the uterus was wanting.

On one point we may in such cases be quite certain, viz., that a true sexless being cannot contract a marriage. A matrimonial separation has been sought on this ground. (*Case* 132.)

Concealed Sex (*Cases* 105, 106, 122).—These cases on examination present, as a rule, no difficulty. For some reason the individual has chosen to conceal his or her sex, and to pass off as belonging to the opposite sex to that to which he or she belongs. In many cases this is to be accounted for by addiction to gross forms of immorality. In my own experience of two cases this was clearly the object in view. It may, however, in some instances be mere eccentricity.

3. If the Individual in question be Male or Female, or Both in One, is it capable of procreating its Kind?

The question of sterility and impotence will be more fully discussed hereafter. We need only remark here that although there can be no doubt that the great majority of so-called hermaphrodites are sterile, yet that spermatozoa have been found in the seminal secretions of certain of these individuals.

Mr. Savory's sheep, to which reference has already been made, is almost eclipsed by Sir Everard Home's bull ("*Phil. Trans.*," 1799). This animal had begotten five calves. It possessed ordinary male organs, and had the general appearance of a male except in the flanks and hind-quarters. It possessed, however, in addition, an udder and teats affording milk, and a small vagina capable of admitting the male organ.

Conclusions.

1. Given the presence of testicles or of a testicle, wherever they or it may be placed, and of a single opening communicating with a bladder and not with a uterus, more particularly if there be seminal emissions containing spermatozoa and an absence of periodic hemorrhages, the individual in question is to be accounted as belonging to the male sex, and that independently altogether of anatomical malformations, such as the presence of an imperforate penis, or even the entire absence of a penis, or the existence of feminine configuration and instincts.

2. Given the presence of ovaries or of an ovary, more particularly if there be periodic hemorrhages, the individual in question is to be accounted as belonging to the female sex, and that independently altogether of anatomical malformations, such as the existence of a penis-like body, or of male configuration and instincts.

Given the presence of glands that may be either ovaries or testicles, and the precise nature of which there is a difficulty in deciding:

—or, given the absence of both ovaries and testicles, together with, in either case, the absence both of seminal emissions and of periodic hemorrhages—then the presence of a uterus, and of a second opening below and distinct from the opening to the bladder, must be sought for. If a uterus or a second opening of the nature described be found, the individual is to be accounted as belonging to the female sex, and that independently of anatomical malformations, or of male configuration and instincts. But if, on the contrary, there be no uterus, and no second opening below and distinct from the opening to the bladder, then the male sex is strongly indicated.

4. When the anatomical conditions are so evenly balanced that neither sex seems to prevail, the existence of periodic hemorrhages are to be regarded as strongly indicative of the sex being female, whilst, on the other hand, the existence of emissions are strongly indicative of the sex being male. In the latter case, however, if spermatozoa in such emissions can be detected, the proof that the individual is of the male sex is complete.

5. The sexual inclinations, the habits and tastes, and the general conformation of the body should in all cases be considered. If they support the conclusions based on the principles laid down in the preceding paragraphs they may be regarded as valuable confirmatory evidence. But if, on the contrary, they fail to confirm, or even appear at variance with, such conclusions, they may then be entirely disregarded.

EXAMINATION OF CASES OF DOUBTFUL SEX.

(*a.*) In the case of *infants*, inform the parents and friends at the earliest possible moment after birth that certain abnormalities exist, rendering the sex of the child doubtful, but give no decided opinion as to the sex that doth prevail until, at least, the child arrive at puberty. It is well that the name in which the child is baptized should be one that would answer for either sex.

(*b.*) Watch the infant closely year by year, noticing particularly (1) its physical development, and (2) moral characteristics (viz., tastes, habits, and propensities).

(*c.*) Remember that the recorded cases of a similar kind show that the probabilities are greatly in favor of the child belonging to the male sex.

(*d.*) In the case of adults the medical jurist should believe nothing but what he can absolutely prove. Mere statements, whether from friends or from the individual, as to seminal emissions or menstruation, are not to be trusted.

(*e*.) So-called "*seminal emissions*," in the absence of a well-marked male organ, and particularly in the absence of spermatozoa, constitute evidence of no practical value as indicative of the individual in question being a male.

(*f*.) So-called "*menstrual discharges*," unless such discharges can be proved to be periodic, constitute evidence of no practical value as indicative of the individual in question being a female.

(*g*.) But, independently altogether of anatomical peculiarities, it is certain that the emission of a fluid containing spermatozoa affords the strongest possible evidence of the individual in question being a male, and that in like manner periodic hemorrhages from any opening about the genitals afford the strongest possible evidence of the individual being a female. Such emissions and discharges must, however, be most minutely and personally investigated by the jurist, and not received on the testimony of others.

(*h*.) Carefully note the general conformation of the individual as follows:—

(α.) The width of the shoulders and hips.

(In the male the shoulders are usually wider than the hips, while in the female it is the opposite.)

(β.) The development of the muscles.

(γ.) The distance between the pubes and umbilicus, and between the umbilicus and scrobiculus cordis.

(In the male the distance between the pubes and umbilicus is shorter than between the umbilicus and scrobiculus cordis, the reverse being the case in females.)

(δ.) The extent to which the sexual hairs extend toward the umbilicus.

(The sexual hairs extend higher toward the umbilicus in the male than in the female.)

(ε.) The general development of the hair of the face.

(ζ.) The development of the breasts.

(Here note not so much the size or adipose growth of the breasts, as the development of the glands and nipples.)

(*i*.) The precise position of the orifice through which the urine passes:—

If a penis-like body exists, the questions to be considered are—(1.) Whether it be perforate or imperforate? (2.) Whether it has a free and distinct prepuce, or whether the hood-like cover of the organ is connected (as is usual in cases of enlarged clitoris) with what answers to the nymphæ? (3.) Whether the corpus spongiosum is or is not *developed*?

There yet remains two further anatomical characteristics, to which it is needful in deciding questions of sex to give the greatest possible attention :—

(*k.*) *The presence of a Vagina and Uterus.*

All openings about the genital organs must be carefully sounded in order to determine their precise depth and direction.

Mr. Curling points out that one of the chief diagnostic signs on which to rely in determining sex in the living, is the presence of a second canal below the urethra and in front of the rectum, either opening separately in the perinæum, or branching off from a common canal opening externally. Mr. Curling states that a second canal "is never met with in any malformation of the male organs," and if present "is sufficient to enable the practitioner to decide satisfactorily on the sex being feminine." ("*Medical Times and Gazette,*" Vol. XXV., p. 85.)

(*l.*) *The presence of Ovaries or Testicles.*

As we have already said, the genital glands are the only real test of sex. Hence, it is most important to examine these organs with the utmost care to determine if possible their precise nature. Virchow has pointed out that the softer the body, the more likely it is to be a testicle.

In the ovary, the firm basis of connective tissue preponderates greatly over the gland-like structure of the Graafian follicle. In feminine hermaphrodites the ovaries are often imperfect, and appear as small, hard, atrophied formations, without follicles. Such a condition of the ovaries may occur, too, at early periods of life in virgins, as well as at later periods from inflammation.

To decide that a given body is a testicle, one would demand at any rate that some solitary seminal tubule should exist, seeing that in the normal testicle these tubules are present in such numbers that on section the organ appears almost to be made up of them and nothing else. No doubt in cryptorchids the testicles may become diminutive, but they never become hard and fibrous like the ovaries, but more often soft and relaxed.

(*m.*) Lastly, it will be necessary to note carefully the sexual inclinations and desires of the individual. These, however, are not to be overestimated, seeing that sexual feelings may arise between individuals of the same sex. And so far as habits are concerned, education and general bringing up must be allowed their full value. Thus, a girl brought up as a boy will necessarily be more boyish than girlish in her habits and tastes, and *vice versâ.*

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ILLUSTRATIVE CASES.

ACARDIAC, ACEPHALIC, MICROCEPHALIC, ANENCEPHALIC, AND OTHER CASES.

1. **British Med. Journ., Aug. 23, 1879, p. 303.**—Twins. One child was healthy and well developed, and the other acardiac. The acardiac twin weighed between 3 and 4 pounds. It presented at one spot a quantity of hair, although the cranium was only partially developed. There was one projection corresponding to an upper, and a second corresponding to a lower extremity. The spinal column, ribs, and pelvis were well developed. Well-developed blood-vessels existed in the extremities. The fœtus presented the normal color of a newly born infant, showing that it must have been alive nearly up to the time of birth. (Page 277.)

2. **Edin. Med. Journ., Vol. XXIII., p. 46 (with drawing).**—(*Professor Simpson.*)—A twin birth, the one child being acardiac and the other well developed, although of small size. Portions of the intestinal canal were the only viscera present in the acardiac twin. (Page 277.)

3. **British Med. Journ., 1873, I., p. 431.**—(From "*Records of the Hôpital des Cliniques.*")—Twin birth. One child perfect, the other consisting only of an ovoid trunk without neck, head, legs, or arms. (Page 277.)

4. **British Med. Journ., May 30, 1874, pp. 712 and 809.**—(*Dr. Godson.*)—A twin acephalous fœtus. It was born between the fifth and sixth months of utero-gestation, but showed signs of not more than three months' development. There was no trace either of head or of the upper extremities. (Page 277.)

This abnormality was probably the result of amputation.

5. **British Med. Journ., 1870, II., p. 115.**—(*Dr. Greene.*)—An acephalous fœtus, still-born. Weight, 10 lbs. (Page 277.)

[This was said to have been the third time that the woman had given birth to a similar monster.]

6. **New York Med. Journ., VIII., p. 104.**—A remarkable fœtus described as consisting merely of parts below the umbilicus. (Page 277.)

7. **British Med. Journ., 1876, II., p. 8.**—(*Mr. Tinley.*)—A full-time acephalous fœtus, with spinal malformation. Weight, 2½ lbs. (Page 277.)

8. **New York Med. Journ., Vol. XI., p. 458.**—Æt. 6½. Height, 3½ feet. Head, 13½ inches circumference, and 6½ inches transversely from ear to ear. Brain almost entirely wanting. The child could neither walk nor speak. Its movements were swinging and ape-like. (Pages 277, 279.)

9. **New York Med. Journ., Vol. XI., p. 458.**—Æt. 3. Head, 16½ inches in circumference, and 10 inches transversely. Brain almost entirely wanting. Movements ape-like. (Pages 277, 279.)

10. **British Med. Journ., Aug. 17, 1872, p. 183.**—(*Dr. Kennedy.*)—Female. Lived for 1½ hour, and cried loudly. Generally it appeared to be well developed, but was totally devoid of brain. Its expirations were somewhat convulsive. It moved its limbs freely, and was acutely sensitive to impressions made on the surface of its body. It was difficult to say whether it could see, hear, or swallow. (Pages 277, 279.)

11. **Lancet, April 23, 1881, p. 683.**—(*Dr. MacDonald.*)—Female. Lived for a few minutes. Well-developed face, but an absence of forehead and cranial vault. The medulla oblongata was intact, and a trace of cerebellum also existed. (Page 277.)

12. **Amer. Journ. of Med. Sciences, Vol. LIV. (1867), p. 281.**—(*Dr. Moore.*)—The entire occipital bone (excepting the basilar process), and also the parietals and the frontal to the superciliary ridges were absent. There was no trace of brain. (Page 277.)

13. **Lancet, 1879, I., 503.**—(*Dr. Stephens.*)—A monoptic anencephalous fœtus of large size and perfect formation. (Page 277.)

14. **Lancet, 1878, I., 456.**—(*Dr. Highet.*)—One-half of the cranium was absent, and the brain (such as existed) was a dark, putty-like mass. The frontal bone was larger than usual, and curving inward, was attached to the anterior portion of the upper vertebræ. (Page 277.)

15. **Lancet, 1876, II., p. 488.**—(*Dr. Waghorn.*)—An anencephalic fœtus. The child was buried by the parents, but afterward exhumed. The parents were charged with murdering the child by battering its head. (Pages 277, 279.)

16. **Edin. Med. Journ., Vol. XIV., p. 564.**—(*Dr. Inglis.*)—An anencephalic fœtus. The child was alive and thriving when two months old, but was blind and unable to shut its mouth. (Page 277.)

17. **Med. Times and Gazette, 1875, II., p. 693.**—(*Mr. Oliver Barber.*)—An anencephalic fœtus without spinal cord. (Page 277.)

18. **Lancet, 1872, I., p. 465.**—(*Dr. Joy.*)—An anencephalic male twin. Weight, 9½ lbs. It had neither arms, shoulders, nor thorax. (The other twin was normal.) (Page 277.)

19. **Lancet, 1874, I., p. 233.**—Report by the Medical Society on an anencephalic fœtus. (Page 277.)

20. **Lancet, July 15, 1876, p. 107.**—(*Dr. Rogers.*)—Still-born. Well developed, but anencephalic. (Page 277.)

21. **British Med. Journal, Jan. 8, 1876, p. 55.**—(*Dr. Symes Thompson.*)—An anencephalic fœtus. (Page 277.)

22. **British Med. Journal, May 25, 1878, p. 752.**—(*Dr. Well Hubbard.*)—An anencephalic fœtus which lived for 20 minutes. (Page 277.)

23. **Lancet, 1876, II., p. 525.**—An anencephalic fœtus. (Page 277.)

24. **Lancet, 1876, II., p. 525.**—(*Mr. J. M. Lang.*)—An anencephalic fœtus which lived for 5 minutes. (Page 277.)

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25. **Lancet, 1877, II., p. 480.**—(*Mr. Thain.*)—A child born without arms, but otherwise normal and healthy. (Page 277.)

26. **Medical Record, 1873, p. 560.**—Female, æt. 10. The arms were wanting, but there was a projection attached to the outer end of the right scapula. She used her feet to eat with, to sew, etc. (Page 277.)

27. **Medical Times and Gazette, 1873, I., p. 26.**—(*Dr. Stanistreet.*)—Male. The right arm and the penis, anus, and urethra were wanting. (Pages 277, 286.)

28. **American Journ. of Med. Science, Vol. LXIII., p. 570.**—(*Dr. Schermerhorn.*)—Female: weight, 4 lbs.; still-born. No nose and one central eye. (Page 277.)

29. **American Journ. of Med. Science, Vol. LXII., p. 574.**—(*Dr. Taylor, of Philadelphia.*)—A male. Lived seven days, during which time it took no food whatsoever. Left eye, nose, or even an opening for a nose wanting. (Page 277.)

30. **British Med. Journ., 1875, II., p. 71.**—(*Dr. Wallace.*)—Fœtus with one eye and no tongue. (Page 277.)

31. **New York Med. Journ., XVI., p. 217.**—(*Assistant-Surgeon McConnell.*)—Male, æt. 25. The opening of the auditory canal existed, but the ears were entirely wanting. The person was very deaf, but could hear a little through the mouth. (Page 277.)

32. **Medical Record, 1873, p. 549; and Indian Med. Gazette, July 1, 1873.**—(*Mr. Garden.*)—Female: lived four hours. No large intestine and no anus, the small intestine opening above the bladder. The left leg from the knee downward originated from the upper end of the thigh and femur. (Page 277.)

33. **Medical Record, 1875, I., p. 71.**—(*Dr. Gherini.*)—Male, æt. 3 (a twin), six fingers on each hand but no thumb, and nine toes on each foot. (Page 277.)

34. **British Medical Journal, 1876, II., 77.**—(*Mr. Walter.*)—Male. Lived and cried for one hour. Six fingers and toes on each hand and foot. Eyes not formed. There was an absence of the occipital bone, and imperfectly formed frontal bones. A rudimentary penis existed, and one testicle only had descended into the scrotum. (Pages 277, 286.)

35. **British Med. Journal, 1875, I., p. 361; Lancet, 1875, I., p. 392.**—(*Dr. Kidd, of Dublin.*)—A seven months' fœtus. Sex (?). The lower extremities were completely united down to the heels. There were neither kidneys, anus, nor genitals, and a mere rudimentary bladder. (A human syren or dolphin.) (Pages 277, 279, 289.)

[Similar case in the Vienna Pathological Museum. (See "British Med. Journal," December 23, 1871, p. 740.)]

36. **Edin. Med. Journal, Vol. XIX., p. 590.**—(*Dr. Maclaren.*)—Male: weight 4 lbs. 10 ozs.: alive when born. The legs were completely fused together (a human syren). The penis was placed on the posterior part of the body. (Pages 277, 279.)

37. **Lancet, 1879, I., 467.**—(*Dr. Granishaw.*)—An eight months' child. Weight, 6 lbs. 3 ozs. No nose or eyes. Penis, 1½ inch long, with glans and patent urethra placed above the eyebrows. Anus imperforate. The child died soon after birth, but cried, and voided urine (!). (Pages 277, 279.)

38. **Lancet, 1875, II., 689.**—(*Dr. Morris.*)—Face pig-like, the body apparently consisting of a left leg. The child breathed for fifteen minutes. (Pages 277, 279.)

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39. **Lancet, 1879, I., 374.**—Organs of generation imperceptibly developed in a full-term fœtus. (Page 289.)

40. **British Med. Journ., 1879, II., p. 641.**—(*Dr. Pithie.*)—Seven months' fœtus. Sex (?). Lived eight days, and passed both urine and fæces. The ends both of the rectum and urinary meatus terminated in the abdomen. There were no signs of either penis or vagina. (Page 289.)

41. **British Med. Journ., 1875, I., p. 275 (with plate.)**—(*Dr. Sheehy.*)—Sex doubtful. Breathed during labor, but was still-born. Weighed 9 lbs. 7 ozs. The thorax was well developed, but the lower part of the body was imperfect, without abdominal walls. (Page 289.)

42. **Amer. Journal of Med. Sciences, Vol. LIII., p. 418.**—(*Dr. Getchell.*)—Sex (?); lived 30 minutes; all the abdominal organs were external, covered only by a thin serous membrane. There were neither arms nor genital organs. (Page 289.)

43. **British Med. Journal, 1877, II., p. 748.**—(*Mr. Brereton.*)—Seven months' child: lived 9 minutes. Penis of abnormal shape without glans, the orifice being very large. Scrotum and testicles absent. (Page 289.)

44. **Edin. Med. Journal, Vol. XVIII., p. 415.**—(*Mr. Imlach.*)—Absence of genital organs, with deficiency of anterior abdominal wall. (Page 289.)

45. **Edin. Med. Journal, Vol. XVI.**—(*Dr. Matthews Duncan.*)—An ascitic fœtus. Scrotum present, but testicles and anus absent. (Page 289.)

46. **Edin. Med. Journal, Vol. XVI., p. 938.**—(*Dr. Matthews Duncan.*)—An eight months' fœtus, without genito-urinary organs. Lived for 48 hours. (Page 289.)

47. **British Med. Journal, 1879, II., 654, and Lancet, 1879, II., 697.**—(*Dr. Ord.*)—Male: æt. 36. On the right side there was found a surviving Müllerian duct, the testicle on that side not having descended, with incomplete development of vesiculæ seminales and vas deferens. On the right kidney a small gland was found, which Dr. Ord suggests was a Wolffian body. (Page 281.)

(For a case of the persistence of Müller's canal in a boy æt. 6, see "British Med. Journal," Sept. 6, 1879, taken from "Journal de l'Anat. et de la Phys.," by M. Rémy.)

48. **Amer. Journal of Med. Sciences, Vol. LXIV., p. 575.**—(*Dr. Brown, of Baltimore.*)—Female; æt. 19.

Post-Mortem.—Vagina (without clitoris or hymen) about 2 inches long,

ending in a cul-de-sac. There was no uterus, the bladder and rectum being in contact. The ovaries were present, and the mammæ well formed.

Sexual desires during life were said to be distinct. Vicarious menstruation occurred by epistaxis. (Page 289.)

49. **London Med. Record, 1874, p. 521 (from the Berliner Klinisch. Wochens., June 15, 1874.)**—Great hypertrophy of the preputium clitoridis. (Page 285.)

UNITED TWINS.

50. **British Med. Journal, 1875, I., p. 508.**—(*Dr. Hadley.*)—Female twins united in the median line by a band extending from the lower part of the sternum to the umbilicus. One was still-born, but the other breathed during birth. (Page 278.)

51. **British Med. Journal, 1880, I., p. 698.**—(*Dr. Murphy.*)—Female twins, united by the front of the thorax and the upper part of the abdomen. Lived a few minutes. (Page 278.)

52. **British Med. Journal, 1880, I., pp. 982 and 897.**—(*Dr. Thompson, of Bideford.*)—Female twins united from the umbilicus to the ensiform cartilage. Weight, 12 lbs. Well developed. They lived 10 days, one dying a little before the other. Each enjoyed independent individuality. (Pages 278, 280.)

53. **British Med. Journal, Feb. 13, 1869, p. 141; 1874, I., pp. 352, 359, 459, and other medical papers.**—(Case of the Siamese twins, Chang and Eng.) Lived to adult life. They were united by a band stretched from the ensiform cartilage to the umbilicus. One umbilicus only. Neither the circulations nor the respirations were synchronous. They were dual in mind, and the urines of the two were found at times to be chemically different. They died in 1874, one surviving the other about two hours. (Pages 278, 280.)

54. **London Med. Record, 1874, p. 572.**—Twins, united at the epigastrium. One was dead, and the other alive when born. The dead twin was removed, but the second child only lived for three days after the operation had been performed. (Page 278.)

55. **London Med. Record, 1875, p. 354.**—(*Professor von Buhl, of Munich.*)—Twins, united from the sternum to the umbilicus. (Page 278.)

56. **London Med. Record, 1877, p. 207.**—(*M. Blot.*)—Twin females, born at full term. One child only alive at birth. They were united from the umbilicus to the upper portion of the chest. (Page 278.)

57. **British Med. Journal, 1874, I., p. 495.**—(*Dr. Heywood, of Maryland.*)—Female twins. Weight, 14 lbs. Well formed. United from below the nipples to the umbilical cord. (Page 278.)

58. **British Med. Journ., 1872, II., p. 658.**—(*Dr. Sangalli.*)—Twins, united by the thorax and abdomen. (Page 278.)

59. **British Med. Journ., 1873, I., p. 39.**—(*Mr. Houel.*)—Female twins, still-born. United by the pelvis. (Page 278.)

60. **British Med. Journ., 1873, I., p. 294, and 1871, I., p. 562.**—(*Account by Virchow.*)—(Case of Miss Millie Christine, the two-headed Nightingale.) In this case the approximation of the spinal columns begins at the second lumbar vertebra and is complete in the sacral region. There are two heads and four legs, but a single anus and vaginal orifice. There appears to be perfect independence of thought and motion. (Pages 278, 280.)

61. **Med. Times and Gazette, 1880, II., p. 651.**—(*Dr. Playfair.*)—Twin females (æt. 3), well formed. The pelvis common to both. Vagina double, but a single anus and urethra. All other parts double. The sensations distinct except at the pelvis. (Pages 278, 280.)

62. **British Med. Journ., 1873, I., p. 262.**—A fœtus with a single trunk, but two heads and four legs. (Page 278.)

63. **British Med. Journ., 1878, II., p. 341.**—(*Mr. J. E. Eaton.*)—A five months' fœtus. Two heads and four legs, but a single body, the union commencing at the top of the sternum. (Page 278.)

64. **Medical Record, 1874, p. 16.**—(*Dr. Bent, of Argyle, N. S.*)—A twin male monster. Born alive. Three legs in perfect use. Two sets of genitals. Two perfect and two imperfect arms. One fairly developed and a second undeveloped head, the latter placed half-way down the left side of the neck. (Page 278.)

65. **Lancet, 1876, II., p. 313.**—(*Dr. Tweedy.*)—Twins, joined together at the vertex of the cranium. One fœtus was small, without legs or pelvic portion, and merely terminating abdominally in a bloody mass. The other was large, with arms, but without well-developed legs. They lived for five minutes after birth. (Page 278.)

66. **British Med. Journal, 1877, II., p. 934.**—(*Dr. Heschl, of Vienna.*)—(Case of Blanche Dumas.) Female, æt. 17. The lower half of the body double, the spinal column dividing at the second lumbar vertebra. Two pelves and two sets of genitals. The left anus somewhat imperfect.

Urination and menstruation take place from both sets of organs. (Page 278.)

67. **Lancet, 1874, I., p. 352.**—(*Dr. Balle, of Faculté de Médicin, Paris.*) —Female, æt. 14 when examined. Single above, but double from the waist downward. Each part acts independently. (Pages 278, 280.)

68. **New York Med. Journal, VIII., p. 102.**—*Profs. Jones and Eve, of Nashville.*)—A twin female. Was alive and well when five weeks old. Single above, but double below, the division commencing about the junction of the spine and sacrum. Double anus and double organs of generation. (Page 278.)

69. **Lancet, 1879, I., p. 143.**—(*Dr. Webb.*)—Female. Two heads fused into one, with a single face. Single above the umbilicus, but double below. (Page 278.)

70. **Lancet, 1876, II., 525.**—(*Dr. Clarke.*)—Still-born. United from pubis upward, the two heads being amalgamated. Genital and anal orifices double. (Page 278.)

71. **British Med. Journal, 1879, II., p. 628.**—Still-born. The upper part of the fœtus single, but with two faces. The lower part double. (Page 278.)

72. **British Med. Journal, 1880, I., p. 971.**—(*Dr. Maclaurin.*)—One head and a single body as low as the umbilicus. Below this the fœtus was double. (Page 278.)

73. **Med. Press and Circular, 1880, I., p. 518.**—(*Dr. Chalmers.*) —Twin birth. The upper part single with one head, and the lower part double. (Page 278.)

74. **American Journal of Medical Sciences, Vol. LXI., p. 299.** —Twin females. Weight, 10 lbs. Single above the pelvis and double below. (Page 278.)

75. **British Med. Journal, March 13, 1869, p. 230.**—Case of Rita Christina. Female. Double above, single below. Lived eight months. (Page 278.)

76. **British Med. Journal, 1871, II., p. 268. (From "Boston Herald.")**—A two-headed child with four arms and two legs. Lived for nine months, the one half dying three hours before the other half. (Page 278.)

77. **Med. Times and Gazette, 1878, II., p. 577.**—(*Mr. MacCullum, of Canada.*)—United female children, living, intelligent, and well-formed.

The union commences at the lower part of the thorax. There is but one abdomen, but distinct spinal columns, one navel, one set of genitals, and two legs, the pelvis being common to both. Neither the cardiac, digestive, spinal, nor respiratory movements appear synchronous, and sensation is independent. (Pages 278, 280.)

78. **New York Med. Journ., Vol. VIII., p. 571.**—Still-born, but mature. The mother states she felt the child alive the day before its birth. It had two heads and two necks, between which a large third arm projected. Single below. (Page 278.)

79. **Lancet, 1872, I., p. 538 (with plate).**—(*Mr. Muggeridge.*)—A female, still-born. Two-headed. (Page 278.)

80. **London Med. Record, 1878, p. 311.**—(*Dr. Tischler.*)—A fœtus double above the loins, single below. (Page 278.)

81. **Edin. Med. Journal, Vol. XX., p. 702 (with plate).**—(*Dr. Macdonald, of Edinburgh.*)—Female; eight months' fœtus; weight, 3¼ lbs. The trunk and extremities normal, except spina bifida. The face double, there being one eye to each face and one large compound eye in the median line with two eyeballs. (Page 278.)

82. **British Med. Journ., 1875, I., p. 412.**—(*Mr. Thompson.*)—Male, double above, with two well-formed heads. Male genitals perfect. Three lower extremities. (Page 278.)

83. **Lancet, 1872, I., p. 886.**—Two heads and a single trunk with two legs, and one supplementary leg. One portion of the body was said to have lived thirty hours after birth, whilst the other part died after five hours from convulsions. (Page 278.)

84. **Medical Times and Gazette, July 27, 1872, p. 99 (with drawing).**—(*Mr. Wasdale Watson.*)—A double monster; weight, 8¼ lbs. Length, 22 inches. A single body, with no noticeable mark indicating where the union was situated, a head being placed at each end of the trunk. There were three legs situated at the side of the trunk. Both heads cried vigorously. Two vaginæ. One child died six hours after birth, the other twenty-six hours. The details of the post-mortem are given. (Page 278.)

Cases of Hypospadias.

85. **Berlin. Klin. Wochens., July 5, 1875, and Lond. Med. Rec., 1875, p. 525.**—(*Dr. Schœneberg.*)—Æt. 16 when the subject of the memoir first came under observation. Up to this time the parents had regarded him as a girl, although the general conformation, indicated by the unde-

veloped breasts, small pelvis, harsh voice, and prominent larynx were masculine.

A testicle, round, movable, tender, and the size of a hazel-nut, was present in the [supposed] right labium. The penis was 2½ in. long, imperforate, but with a well-formed glans. The urethral orifice was some distance below the penis, and further back was a shallow depression about 5 centimeters deep surrounded by a ring, and partly closed by a sort of hymen, not unlike a vaginal orifice. No internal genital organ except the testis could be made out.

At 20 years old, male characteristics, such as a growth of beard and sexual excitement with a fluid discharge when in contact with females, developed themselves. (Pages 286, 288.)

86. **Med. Times and Gazette, Feb. 7, 1852.**—(*Mr. Fletcher.*)—Æt. a few weeks when the child came under observation. A small spherical body like a testis was observed in each half of the cleft scrotum. There was a very small imperforate penis, with glans and prepuce. The prepuce was slit from above downward, forming two folds of membrane (like labia minora), which were continued from the root of the organ along the floor of the fissure, ending on each side of a circular orifice placed midway between the lower end of the labia majora, and which led to the bladder. There was no passage inferiorly. (Page 288.)

87. **Edin. Med. Journ., Vol. XLIII., p. 313.**—(*Dr. Handyside.*)—Supposed to be a girl until 16. One testicle was found on the right side of the scrotum and the other in the right groin, supposed by the parents to be a rupture. (Page 288.)

88. **Cormack's Monthly Journ., April, 1845, p. 307.**—(*Mr. Terry.*)—A child believed to be a female until two months old. One testicle only had descended. (Pages 287, 288.)

89. **Cormack's Monthly Journ., July, 1845, p. 531.**—A person regarded as a woman until 26 years of age. Testicles present in the scrotum. (Page 288.)

90. **Edin. Med. Journ., No. 123.**—(*Dr. Handyside and Dr. Bach, of Dresden.*)—Case of Gottlieb Göttlich, born in Saxony in 1798, and baptized as Marie Rosine G. He was employed as a female servant for some years, his sex not being suspected till the spring of 1831, when he fractured his left femur, and was admitted into a hospital at Dresden. At this time, first the left and then the right testis descended, and being accompanied with a strangulated hernia on each occasion, necessitated an operation which led to the discovery of the true sex. His semen had spermatozoa, and he had strong sexual desires. The scrotum was cleft; the

penis one and a half inch long, and imperforate. The general appearance was masculine. (Pages 282, 287, 288.)

91. **Amer. Journal Med. Sciences, July, 1847.**—(*Dr. Barry.*)—(Case of *Levi Suydam*). In the spring of 1847 Suydam presented himself as a free*man*, to vote in a contested election. Dr. Barry found him to be a hypospadiac, with a cleft scrotum and a small but perfect testis in the right half. He pronounced him a male, and entitled to vote. A few days after, it was discovered that Suydam regularly menstruated, and had done so for years. His figure was feminine, and the breasts well developed. On passing a sound into the urethra, instead of its reaching the bladder, it passed into a cavity like a vagina three or four inches deep. It was said that this urethra had been made by the accoucheur who attended at his birth! (Page 288.)

92. **Amer. Journal Med. Sciences, Vol. LIV., p. 282.**—(*Dr. Barton, of Ohio.*)—A cleft penis. The testicles had not descended. The urine passed through an orifice in the right inguinal region. The child lived for seven or eight days. (Page 288.)

93. **British Med. Journal, 1876, I., p. 656.**—(*Dr. Gwynne.*)—Small and imperforate penis, with absence of C. spongiosum. Left testis absent. The parents were anxious about the sex when the child was three weeks old. (Pages 287, 288.)

94. **British Med. Journal, 1876, II., p. 386.**—(*Mr. Franklin.*)—Æt. five months when it first came under observation. The penis had a glans, but no C. spongiosum. There were two slits on each side, but the urethral orifice was below the glans, and to the right of the mesial line. No left testicle. (Page 288.)

95. **London Med. Record, 1877, p. 427.**—(*Dr. Lücke.*)—Male, æt. 19. (Operation for hypospadias successful.) (Page 288.)

96. **Lancet, 1879, II., p. 727.**—(*Mr. Pickering Pick.*)—Æt. 13. Fine grown, healthy, and well-formed hypospadiac. (Operation proved successful.) (Page 288.)

97. **British Med. Journal, 1877, I., p. 392.**—(*Mr. Porter.*)—Æt. 45. Testicles indurated and converted into a cheesy mass. (Page 287.)

98. **British Med. Journal, 1875, I., pp. 221, 688.**—(*Mr. John Wood.*)—Notes of successful operations on two hypospadiacs. (Page 288.)

99. **British Med. Journal, 1876, II., p. 683.**—(*Dr. Cooper Rose.*)—Æt. 15. A hypospadiac brought up and baptized as a girl. (Page 288.)

100. **British Med. Journal, 1872, II., p. 667. Edin. Monthly Journal, Vol. XVIII., pp. 612, 733.**—(*Dr. Graham.*)—Regarded as a girl until 15. The left testicle undescended. The habits (from circumstances) were those of a girl, but the voice was rough. (Pages 287, 288.)

101. **British Med. Journal, Oct. 25, 1873, p. 503.**—(*Dr. Holdsworth.*)—When 13 months old the mother brought the child to the hospital to be treated for what she supposed was a hernia. The parts resembled those of a female, but the supposed vaginal passage ended in a cul-de-sac. There was a rudimentary penis attached to the inner side of the left [so-called] labium. There was a testicle in each labium, with a glans and a ridge where the urethra should be. (Page 288.)

102. **Med. Times and Gazette, June 22, 1872, p. 722.**—(*Mr. John Wood.*)—Æt. 60. A hypospadiac. Passed as a female all his life, and as such was married and had been deserted by the husband. The general appearance was feminine, and the mammæ were well developed. Pelvis transversely female; antero-posteriorly male. Labia majora large; each containing a well-formed testicle. There was a penis or clitoris in the median line of considerable size. Below it and between the rectum and a well-formed prostate was a cul-de-sac an inch in diameter and 1½ inch deep. There was a true vas deferens which ended in the urethra and vesiculæ seminales. (Page 288.)

103. **Med. Times and Gazette, May 21, 1853, p. 538.**—(*Mr. Walters.*)—Æt. 15. A patient in the general ward of a Manchester hospital. Fair. Never menstruated. Countenance feminine, with a slight development of hair on the face and upper lip. Mammæ not developed. Scarcely any development of the mons veneris. The clitoris-like body was 2½ inches long and was covered by a distinct prepuce, under which was an imperforate but grooved glans. In the ordinary position of the external opening of the vagina was an aperture through which a finger could be passed leading upward and backward. This canal terminated in a cul-de-sac, below which was the opening of the urethra. In each so-called labium a movable body was found, which could be pressed upward as far as the external abdominal ring. It had at its upper part a structure presenting the characters of an epididymis. Leading from it was a cord which gave the fingers the sensation of the spermatic cord. No pain resulted when these parts were pressed. Mr. Walters believed the bodies in the labia to be true testicles, and the case one of extreme hypospadias. (Page 288.)

104. **Amer. Journal of Med. Sciences, Oct., 1852.**—(*Dr. Hartshorne.*)—The child was regarded as a girl until two years old, when she commenced showing male proclivities.

Examination: There was neither penis nor vagina. The labia (?) were well developed, each containing a well-formed testicle. There was no indication of uterus or vagina. Dr. Gross removed the testicles, thinking it better for the future happiness of the child to do so (! ! !). So far as giving her girlish likes and proclivities the operation was successful. (Pages 279, 286.)

105. Medical and Phys. Journal, Feb., 1833, p. 168.—The case of Eliza Edwards (æt. 24), who, although a male, passed for a female, and was attended by an eminent physician in his last illness without any suspicion of the truth. The body was sent to Guy's dissecting-room as a female. (Page 290.)

106. Case of Da Costa v. Jones.—(*European Reports*, Vol. II., p. 729.)—The celebrated Chevalier d'Eon, long believed to be a female, was compelled to wear feminine apparel for many years by order of Louis XV. of France. The plaintiff in this case claimed £300 of the defendant (money owing as a bet), provided the Chevalier proved to be a female, the plaintiff having already paid 75 guineas to the defendant on this understanding. The verdict was given for the plaintiff—*i.e.*, a decision that the Chevalier was a female. This was set aside in the Court of King's Bench on the ground that the law did not allow wagers on subjects leading to the introduction of indecent evidence (*contra bonos mores*), nor upon such subjects as were calculated to have an injurious effect upon the interest and character of a third person. Sir Anthony Carlisle afterward examined the Chevalier, and found perfect testicles, and satisfied himself and all others that he was of the male sex. (Page 290.)

107. Rees' Cyclopædia.—(*Quoted from the "Journal de Medicine."*)—An individual supposed to be a woman and living with a husband. Bust, hair, and general development masculine. There was an imperfect penis, two well-formed testicles, and imperfect vesicula seminales. There was an appearance of vulva, the urethra opening at a cul-de-sac representing the vagina. (Page 288.)

108. Taylor's Med. Juris., II., p. 278.—A boy until thirteen years old brought up as a girl owing to the testicles not having descended, when change of voice and development of masculine habits showed the mistake. (Page 287.)

109. Virchow's Archiv, XLV. (1868.)—*Archives Générales*, March, 1869.—*Medical Times and Gazette*, June 28, 1873, p. 691.—(Case of *Catherine Hohmann.*)

The subject was a domestic, forty-three years of age, born of parents perfectly developed. She had four brothers and sisters who were in all respects perfect. The midwife who attended at her birth detected a mal-

formation of the genital organs, but thought it not worth while to inform the parents, the result being that the infant was brought up as a girl. She began to menstruate regularly about the age of ten. In 1866 the flow was arrested for some months, after which the interval of menstruation was reduced to three weeks, the average duration of the discharge being four or five days. For some days previous to the flow she experienced pain and swelling in the breasts, uneasy sensations in the lower part of the abdomen, and nausea. She also occasionally had epistaxis during the periods. The voice resembled that of a woman up to the age of twenty-six. At this time she suffered from pain in the throat, accompanied with difficulty of deglutition, and aphonia. The voice returned shortly afterward, but it was then a male voice and deep-toned.

The hair of the head is long like that of a woman, and of dark color. The chin and upper lip are covered with a number of stiff, harsh hairs, several millimetres in length, the lower extremities being also covered with short hairs in great number. The features are those of a man. The larynx is large, and the pomum Adami prominent. The limbs are bony, and the muscles well outlined. The thorax and pelvis have the male conformation. Respiration is quiet and diaphragmatic. The breasts and nipples are developed like those of a woman.

The genital organs are abundantly covered with hairs. Above is a penis with glands and prepuce. The penis is about three inches in length from the root to the tip of the glans, the glans itself measuring about one inch. In the place of the meatus urinarius there is a depression from which starts a furrow, which passes down on the inferior surface of the penis, like an unclosed urethra, to within six millimetres of the root of the penis. From this point there is a short urethra, with an opening near the root of the penis. On the dorsal surface of the penis are two soft cutaneous folds, which start on a level with the root of the penis, and then, separating somewhat, are lost toward the prepuce upon the lateral surfaces. These folds are apparently the analogues of labia minora. The scrotum is well developed and formed of two unequal halves, the right one being of good size, whilst the left is small, shrivelled up, and resembles a labium. In the right half, which is pendent, there is a well-developed testicle of normal size and consistence; and one can trace very distinctly the epididymis and vas deferens. There is, without doubt, a cremaster muscle, for the least mechanical irritation of the scrotum provokes reflex contractions. At the bottom of the left side of the scrotum there is a hard, ill-defined mass, resembling cicatricial tissue, and which may possibly be a degenerated testicle.

In the left inguinal region there exists a flat body the size of a bean, the nature of which it is difficult to determine. We might, strictly speaking, consider it an atrophied testicle.

"On passing a sound into the urethra, which is of the size of that canal

in an adult man, the bladder is readily reached, no obstacle being met with. On a number of occasions when using a sound of smaller size, and carrying it along the posterior wall of the urethra, it happened that the instrument passed into a sac-like cavity, situated behind the urethral orifice. The sound was readily moved in a lateral direction, and the cavity, considered in relation to its position and form, was held to be that of a well-developed uterus. In following by the rectal touch the movements of the sound, Professor Friederich was convinced that the instrument passed into a cavity near the posterior wall of the urethra, and by passing in a second instrument above the first and making it penetrate the bladder, the extremities of the two instruments were felt to be separated from each other by a wall about one inch in thickness. Neither the rectal touch nor the most careful examination of the parts situated on the sides of this pouch showed the existence of any organ which could be considered either as an ovary or a second testicle. It was also impossible to recognize the existence of a prostate.

"The attractions of this person, Catherine H., were always for women. In the presence of men she experienced a certain degree of repulsion, and she had rejected a number of offers of marriage which had been made to her. In the presence of men she never had erections, which were very frequent when she approached women. She confessed to having had frequent sexual intercourse with a female domestic, for whom she had conceived a deep love. She also acknowleged to having frequently admitted men to her embraces, without, however, having formed for them any attachment.

"She had seminal emissions following lascivious dreams. The fluid discharged was found on microscopical examination to contain spermatozoa, which were normal in movement and appearance. During her stay at the clinique she had one of her periodical flowings, and the blood was seen escaping both in drops and in a continuous flow from the canal of the urethra.

"Her general health was perfect, all other functions being performed with regularity." (Pages 285, 286, 287.)

110. Cincinnati Lancet and Observer, Sept., 1875. London Med. Record, Jan. 15, 1876.—(*Dr. L. Rogers.*)—An unmarried person (woman) æt. 38. The person was hermaphroditic. The mons veneris, labia majora and minora are recorded as well developed. Vaginal orifice small, scarcely admitting a female catheter. A penis-like body 3 in. long and 1 in. thick, curving downward, without prepuce was noted. A web-like membrane extends from the glans along the underside, which when an erection occurs draws the penis down to the upper junction of the labia majora. A tumor was found attached by a long pedicle to the root of the penis, and on removal was found to present all the appearances of a testicle. (*Pages* 285, 289.)

111. American Journ. Med. Sciences, Vol. XXVI., p. 65.—(*Dr. Blackman.*)—Æt. 30. Male appearance, excepting developed breasts. Scrotum cleft. Menstruated monthly. Male desires. (Page 288.)

112. American Journ. Med. Sciences, Vol. XXVI., p. 367.—(*Dr. Burnett.*)—Æt. 26. Formation male, but no testicles found in the scrotum. The individual is said to have menstruated monthly through the penis, and ultimately to have died from cerebral congestion during one of these periods.

P.M. A testicle and an ovary with Fallopian tubes found on each side. A prostate gland and uterus also present.

(See Journal, p. 367, for detailed P.M.)

[See remarks on this case in Amer. Journ. Med. Sciences, 1871, Vol. LXII., p. 123, by Mr. Woodward, who states that the ovary was a mass of adipose tissue, and that there were no Fallopian tubes. The so-called uterus and vagina in the case represent in his opinion the united vesiculæ seminales, the conformation of which is irregular in consequence of the arrest of development due to the non-descent of the testicles.] (Pages 285, 289.)

113. Med. Press and Circular, Vol. I., 1877, p. 214.—(*Dr. Cecciherelli.*)—An hermaphrodite; æt. 14. Mammæ well developed; female organ of generation complete; menstruated regularly. Had had connection with males.

This individual has a testicle, and according to Virchow seminal vesicles which contain spermatozoa. (Page 289.)

114. British Med. Journ., June 2, 1877, p. 685.—(*Dr. Fothergill.*)—(*Also "American Journal of Obstetrics," Feb.*, 1876.)—Case of Hoffman. This being cohabited with a male from 19 to 46, when a change of life occurred. He then felt a preference for females, and had connection indifferently, ultimately taking a wife and dressing as a man. (Page 288.)

115. Med. Gazette, Vol. XL., p. 562.—(*Dr. Harris, of Clarksville.*)—No testicles. A short but naturally formed penis existed, through which the being regularly menstruated. There was a rudimentary vagina, and the general development was that of a female. (Page 288.)

116. Med. Times and Gazette, Jan. 24, 1852, p. 84.—(*Mr. Curling.*)—(1.) A case of twins. In *both* children folds of skin existed resembling a scrotum before the descent of the testicles, divided by a cleft, without any trace of opening or of vagina. There were no signs of testicles. There was a body resembling a penis, with a well-formed denuded glans, but without any corpus spongiosum below the glans. In one, the urethra terminated at the root of the glans (hypospadias), in the other the meatus did not reach so far. One died at the end of seven weeks, and

the other at the end of nine weeks. The post-mortem revealed properly formed ovaries and a uterus, and also a vagina which gradually contracted and terminated anteriorly in a short canal, opening into the uretha close to the neck of the bladder at the part corresponding to the veru montanum, there being a similar eminence in the urethra. A probe introduced at the aperture of the uretha passed both into the bladder, and through the short narrow canal into the vagina. There was also a body not unlike a prostate, but not glandular in structure. (Specimen in R. C. S. Museum.)

[In this case Curling advised that names should be given the children applicable to either sex, but the parents baptized them as boys.]

The mother, eighteen months afterward, was confined of another child similarly malformed, except that the penis-like body was more evidently a clitoris than in the previous cases. It died after four months. The mother was again confined a third time, when she was delivered of a well-formed male child.

(2.) A child, æt. two and a half years, the second child of well-formed parents, and baptized as a boy. It had a fair-sized penis, slightly curved downward, and lodged in the upper part of a cleft. The glans (formed probably by the expansion of the erectile cavernous bodies constituting the clitoris) was denuded, the prepuce being thrown back like a hood. There was no appearance of corpus spongiosum. No meatus urinarius was apparent, but a faint groove existed which ran down and terminated at an oval aperture, which led to the bladder, in the middle of the cleft. Below this was another opening, into which a catheter passed for about an inch. Besides these, there were no other openings, either in the centre of the cleft or in the perinæum. There were no testicles, and the swellings at the side of the cleft resembled labia.

[Mr. Curling believes the lower opening above referred to communicated with a vagina and uterus, and that the penis-like body was a clitoris. He advised dilating the lower orifice by passing a bougie daily. Ultimately the enlarged clitoris was excised.] (Pages 285, 288.)

117. **British Med. Journ., Jan. 3, 1880, p. 20.**—(*From Virchow's "Archiv.,"* Band LXXV.)—Æt. 16. Menstruated at 14½. Developed breasts. No hair on the face, but long brown hair on the head. There was a penis-like body, with a prepuce and urethral furrow two inches long and erectile, curved backward. There was a uterus and vagina, but no prostate nor vesiculæ seminales. Bodies were present which Virchow considered to be ovaries. (Pages 285, 288.)

118. **British Med. Journ., Jan. 27, 1877, p. 108.**—(*Dr. Griffith.*)—A child in whom certain scrotal appendages were found to be labia. The *apparent* penis not perforated, but a urethral orifice found beneath. At

the post-mortem both uterus and ovaries were found. (2.) A child registered as a male found to be a female. The mother attributed the deformity to a fright in the monkey-house at the Zoölogical. (Pages 285, 288.)

119. **Lancet, May 1, 1852, p. 421.**—(*Dr. Chowne.*)—See also "Lancet," Oct. 11, 1851, p. 335, and Jan. 15, 1853, p. 66; "Med. Times and Gazette," Jan. 15, 1853, p. 71.—A female (Joseph Boisdeclince), in all respects well and properly developed, save in great development of beard and whiskers. She was born with hair on her chin, and her beard was two inches long when she was eight years old.

See also **British Med. Journ., 1874, II., p. 659.**—Account of two women living at Constantinople (æt. 20 and 24) who had long flowing beards and whiskers. **London Med. Record, 1877, p. 292.**—(*Dr. Duhring.*)—Female, 23, married, with moustache and beard. This growth of hair did not seem associated with any sexual irregularity. She was the mother of two children. **Lancet, 1873, II., p. 756.**—(*Dr. J. E. Wilson.*)—Female, 32, unmarried; beard and whiskers more than three inches long. The hair commenced growing at the time she first menstruated. No sexual malformation or irregularity. **British Med. Journal, 1877, I., pp. 411, 471.**—Female; æt. 40, married; no children; great growth of hair on the face. (Page 285.)

120. **Lancet, Vol. I., 1873, p. 129.**—(*Dr. Hills.*)—The case of a dressmaker, aged 42, in the Norfolk Asylum, with broad shoulders, undeveloped breasts, thick moustache, and a full beard. The clitoris was very large with a distinct prepuce. There were no signs of testicles, and she had menstruated three times imperfectly at an early age. The lower part of the body was feminine, so far as regards vagina and uterus. She evinced strong sexual passions, and behaved indecently to the attendants. The voice was feminine. (Pages 282, 285, 288.)

121. **Beck's Med. Juris., p. 77.**—Case of Margaret Malaure, a reputed hermaphrodite owing to the existence of prolapsus uteri. (Page 286.)

122. **Taylor's Med. Juris., II., p. 286.**—Dr. James Barry, late Staff-Assistant-Surgeon and Inspector of Hospitals, who had served many years in the army, and had fought at least one duel, was found to be a female. (Page 290.)

123. **Amer. Journ. of Med. Sciences, 1872, p. 512.**—(*Dr. Flunce.*)—External organs and bodily formation in this case were masculine. At the post-mortem a uterus, ovaries, and Fallopian tubes were discovered. The individual had never menstruated. (Page 288.)

124. **Med. Times and Gazette, Feb. 18, 1860, p. 177.**—(*Spencer Wells, Wilks, and Curling.*)—An adult, unmarried, supposed through life to be a male. No suspicion was excited until circumstances necessitated the surgeon passing a catheter. The characters externally were those of a hypospadiac male with undescended testes, but internally thé female characters predominated, and there were no testes. The apparent penis was an enlarged clitoris. There was a small uterus and one ovary. The vagina terminated near the external opening of the urethra. There was some doubt whether or not the vagina terminated in a cul-de-sac. The urethra was about three inches long, some dense fibrous tissue being present at the neck of the bladder, resembling in shape and appearance the prostate, but about half its usual size. There were no traces of vesiculæ seminales nor of vasa deferentia.

[The question of duality of sex in this case arose from the co-existence of prostate and uterus. The Committee of the Pathological Society, to whom the specimen was referred, did not regard the body as a true prostate, no sinus pocularis, nor veru montanum, nor follicles corresponding to the prostatic being visible. Nor again on section of the organ near the mucous membrane were any ducts visible, neither was there any secretion resembling what is seen in the perfect gland.] (Pages 285, 287, 288.)

125. **Liverpool Med. and Surg. Reports, Oct., 1867, and British Med. Journ., June 6, 1868.**—(*Dr. Rawdon.*)—Case of lateral hermaphrodism. A Fallopian tube, round ligament, and par-ovarium (but no testicle or ovary) were found in the left broad ligament, whilst in the right was a Fallopian tube and a testicle with its epididymis and vas deferens. The vagina and uterus were present, and the person was said to have menstruated regularly. (Page 287.)

126. **Taylor's Med. Juris., II., p. 280.**—(*Mentioned by Briand.*)—Æt. 18 at death. In configuration partly male and partly female. From external appearances no conclusion could be formed, but on making a post-mortem a testicle was found in the left [so-called] labium, with an epididymis and spermatic cord attached, whilst on the right side there was an ovary, Fallopian tube, and rudimentary uterus. (Page 289.)

127. **Centralblatt Med. Wissenschaft, June 3, 1871.**—(*Dr. Heppner.*)—Case of bilateral or transverse hermaphrodism. Child two months old. The external genitals were male and the internal female. Testicles were said to have been found as well as ovaries, but neither vasa deferentia nor vesiculæ seminales. (Pages 288, 289.)

128. **Medical Gazette, Vol. XIX., p. 135.**—(*Prof. Mayer, of Bonn.*) —Æt. 55 at death. General configuration that of a woman. (During life celebrated anatomists had formed different opinions as to the sex.)

At the post-mortem there were found on the right side a withered testicle, a penis, and a prostate gland, and on the left an ovary, uterus, vagina, and Fallopian tube. (Pages 287, 289.)

129. Beck's Med. Juris., p. 70.—(*Communicated by M. Maret.*)—Case of Hubert J. Pierre. Died at the age of 17. No down on chin or lip. Breasts of middle size with large areolæ. The bust was feminine, but the hips were imperfectly developed. Penis four inches long with prepuce, but imperforate, a little indentation occurring at the ordinary spot of passage. Under the penis was a fissure resembling that between the labia. The left labium contained a testicle with spermatic vessels, whilst in the right a body descended when the abdomen was pressed which proved to be an imperfect uterus with Fallopian tube and ovary. A rudimentary vagina one inch long was also present. (Pages 287, 289.)

130. Dictionnaire des Sciences Médicales, art. Hermaphrodisme.—The case of Lefort puzzled some of the best anatomists in Paris and London. The chin, chest, and extremities were covered with hair; the breasts were elegantly and perfectly formed. There was a small clitoris, with an imperforate glans. Below were five small openings, through which urine passed. A probe revealed something like a vagina, and she was seen to menstruate. She was supposed to have one ovary and one testis. (Pages 285, 287, 289.)

131. Cormack's Monthly Journ., July 1845, p. 492.—(*Mr. Grigor.*)—A case where both testicles and ovaries were wanting, and no essential features of either sex prevailed. (Page 289.)

132. Ann. d'Hyg., 1872, 2, 149.—(*M. Tardieu.*)—At 25 the being referred to was married. After 2 years steps were taken for a separation. She had neither breasts, vagina, uterus, nor ovaries. She had never menstruated. There was neither penis nor testicles, but the pelvis was male rather than female in conformation. (Page 289.)

133. Med. Times and Gazette, Feb. 21, 1852, p. 187.—(*Dr. Broadhurst.*)—A girl, æt. 16, fair, broad-built, and of feminine features. The mons veneris was covered with hair when she was 4 years old. At 10, the mammæ were well developed, the voice girlish, and the pelvis broad. Springing from between the labia majora was a clitoris 3 inches long and 2 in circumference, the dimensions increasing under excitement. The labia by their expansion resembled a small scrotum. The meatus, which was double its usual capacity, was half an inch below the clitoris in the median line. The bladder only could be felt per rectum, and it was the general opinion that both vagina and uterus were absent. (Pages 285, 286.)

134. **British Med. Journ., 1873, II., p. 366.**—(*Dr. Lichtenberg.*)—Æt. 9. Epispadias. Penis small, but prepuce large. Both testicles were in the scrotum. (Page 289.)

135. **London Med. Record, 1876, p. 562.**—(*E. Küster.*)—Æt. 1½. Epispadias. Penis small. (Page 289.)

136. **Lancet, 1875, II., p. 27.**—Male. Right breast very large with brown areola. No secretion at any time was observed from it. The nipples were of usual size. Genital organs well developed. (Page 274.)

137. **British Med. Journal, 1879, I., p. 630.**—(*Dr. H. S. Wilson.*)—A still-born fœtus. Female external genitals simulated those of the male.—(Page 288.)

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